DISEASES OF THE EYE

A MANUAL

OF THE

DISEASES OF THE EYE

BY

C. MACNAMARA, F.C.U.

SURGEON TO THE WESTMINSTER HOSPITAL

THIRD EDITION.

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PREFACE

TO

THE THIRD EDITION.

THE First Edition of this Manual was published in 1868, and the Second in 1872, during my residence in Calcutta. Since my return to Europe I have revised the work, and hope the Third Edition will be found to sustain the character of those that have gone before it.

C. MACNAMARA.

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BY C. MACNAMARA,

Surgeon to the Mayo and Calcutta Ophthalmic Hospital.

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"Dr. Macnamara entirely adopts the view that cholera is communicated by 'an organic infecting matter passed with the evacuations of those affected.' He argues this point, as well as many others connected with the disease, with great acumen.—I cannot spare space to extract any more from this admirable work, but recommend strongly its perusal by all."—*Dr. E. A. Parkes. Army Medical Department Report for* 1868, London, 1870.

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PLATE I.

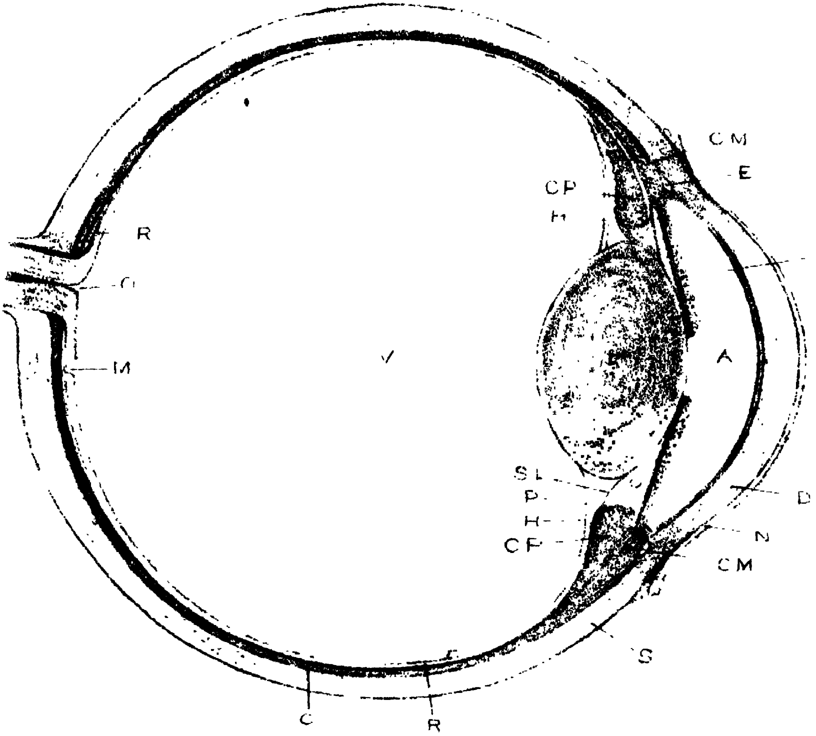

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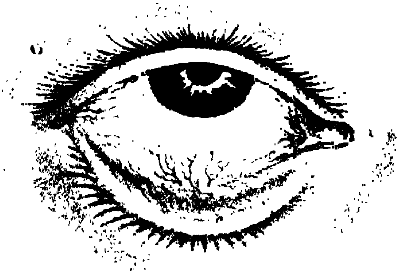
PLATE I.

Diagram of the Human Eye in Section.

S.	Sclerotic ; continued in front into
D.	Cornea.
N.	Epithelial layer of cornea.
C.	Choroid.
I.	Iris.
CP.	Ciliary processes.
CM.	,, muscle.
E.	Circular sinus
R.	Retina.
M.	Macula lutea.
O.	Optic disc.
S.L.	Suspensory ligament of lens.
H.	Hyaloid.
P.	Canal of Petit.
V.	Vitreous.
Q.	Posterior chamber.
A.	Anterior chamber.
L.	Lens.

PLATE II



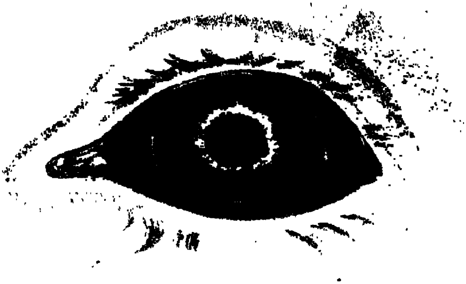


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PLATE II.

FIG. 1.—*Simple Conjunctivitis.*—Both the orbital and palpebral portions of the conjunctiva are hyperæmic or "blood-shot." The everted lower lid is red and villous, and numerous vessels are seen ramifying over the white of the eye, appearing to terminate at the margin of the cornea. (After Dalrymple, Plate VII. fig. 6.)

p. 165.

FIG. 2—*Purulent Conjunctivitis.*—This figure exhibits the intense vascularity and chemosis of the conjunctiva just prior to the second or discharging stage of gonorrhœal ophthalmia. The cornea is still clear, but sunk in the folds of the conjunctiva. (Dalrymple, X. 4.)

p. 177.

PLATE III.

FIG. 1.—*Pustular Conjunctivitis.*—On the conjunctiva, to the outer side of the cornea, is seen one of the so-called "pustules" or phlyctenulæ, and a leash of red vessels is seen feeding it. Another appears just over the margin of the cornea, which is bluish and opaque, from having been the site of former pustules. (Dalrymple, XIII. 3.)

p. 217

FIG. 2.—*Plastic Iritis.*—This figure represents the early stage of inflammation of the iris. A pink zone of sclerotic injection is seen surrounding the cornea, which is itself clear and unaffected. The iris is dull, and the margin of the pupil somewhat different in colour from the rest, and slightly irregular. The conjunctival hyperæmia is trifling. (Dalrymple, XVIII. 1.)

p. 304.

PLATE IV.

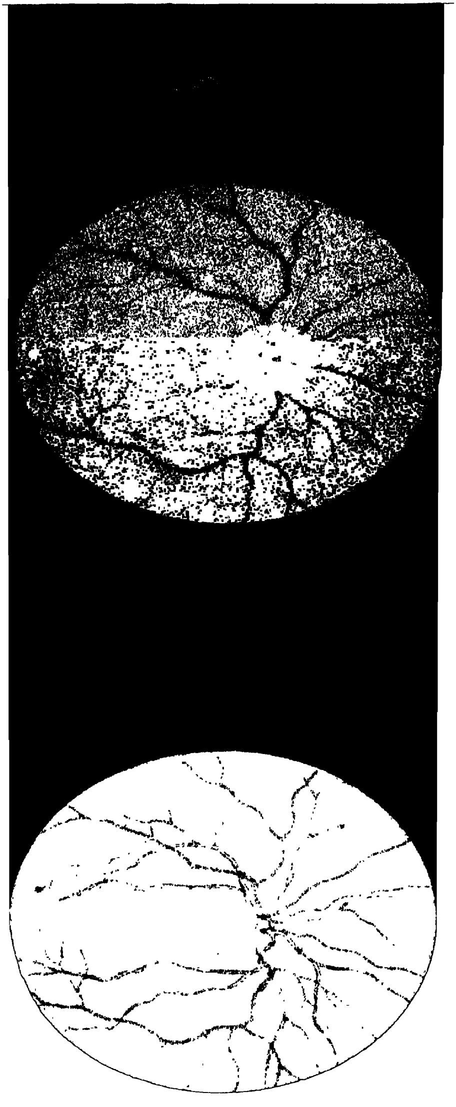


PLATE IV.

Fig. 1.—*Fundus of the Healthy Eye* (European).—The general colour is orange-red, while the optic disc is yellowish-white. The central artery and vein of the retina are seen emerging from the disc and ramifying over the fundus. The arteries present a double contour; the veins are larger and more distinct.

Fig. 2.—*Fundus of the Healthy Eye* (Native of India).—The colour of the fundus is a brownish-grey, and the optic disc of a pale rose tint. In other respects it resembles that of the European.

p. 40.

PLATE.V.

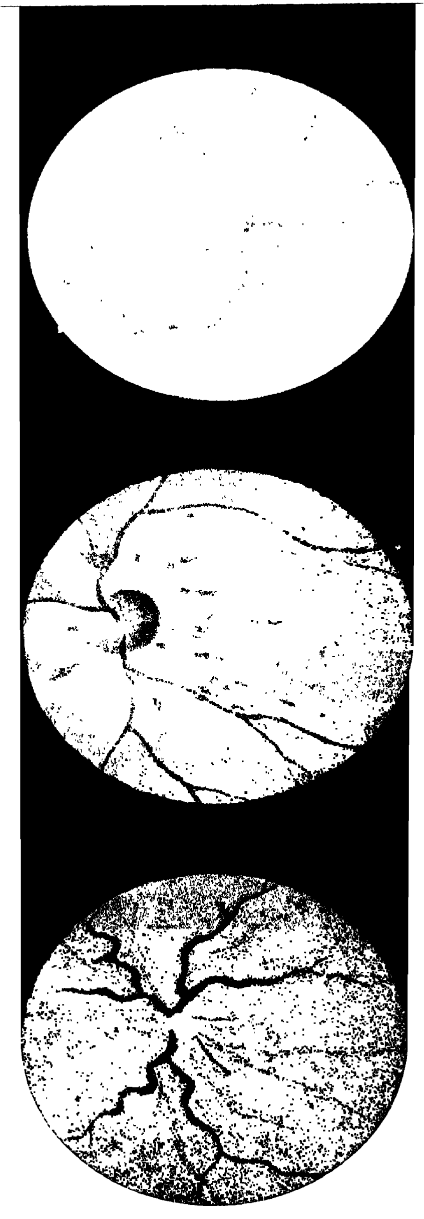


PLATE V.

FIG. 1.—*Hyperæmia of the Retina* (malarial, in Native).—The pink tint, which has replaced the natural grey of the healthy fundus, indicates congestion. The vessels are foggy and indistinct, from the œdematous condition of parts.

p. 396.

FIG. 2.—*Neuro-Retinitis in Bright's Disease.*—The white glistening patches are the product of fatty degeneration. The optic disc is ill-defined from serous effusion, and numerous small, radiating, brush-like extravasations of blood are seen scattered about. (After Liebreich.)

p. 413.

FIG. 3.—*Inflammation of the Retina.*—The optic disc is in great part of the same scarlet colour as the rest of the fundus : the whole appears hazy and œdematous. The central artery is of normal size, but the vein greatly enlarged and remarkably tortuous. (After Jaeger.)

p. 405.

PLATE VI.

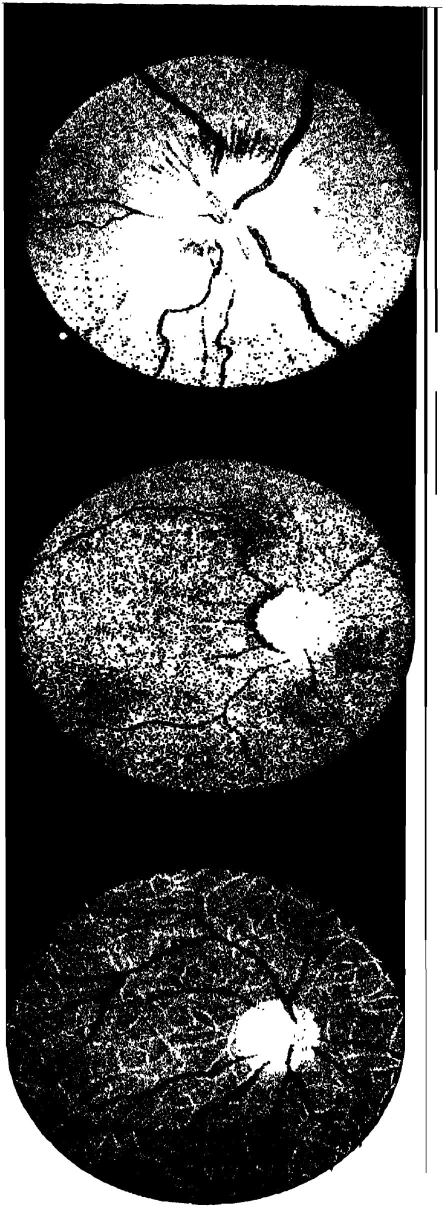


PLATE VI.

FIG. 1.—*Optic Neuritis.*—The fundus is uniformly scarlet, and the optic disc and entrance of the retinal vessels surrounded and veiled by an œdematous haze. The vein is deeply congested and tortuous. (After Liebreich.)

p. 450.

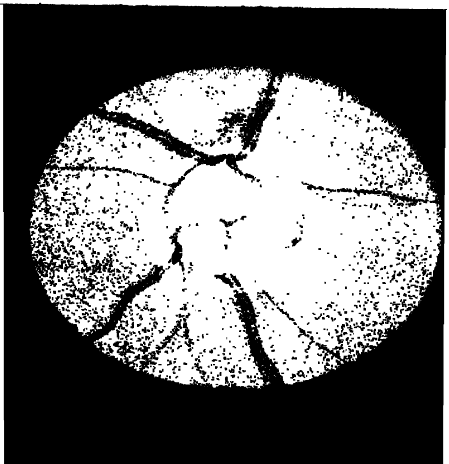
FIG. 2.—*Consecutive Atrophy of the Papilla.*—The result of optic neuritis. The disc is whitish and flat, and presents an irregular margin, with black pigmentary deposits. The vessels are small and contracted. (Altered from Galezowski, Fig. 6.)

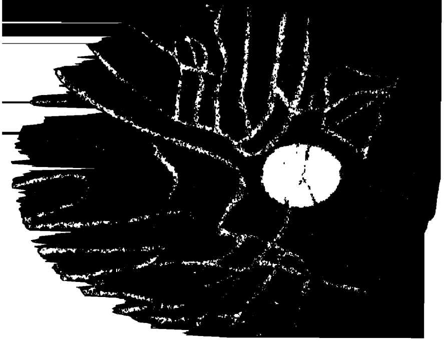
p. 452.

FIG. 3.—*Primary Atrophy of the Papilla.*—The optic disc displays the pearly-white, circular, and flat appearance which is characteristic of the disease. The retinal vessels are of normal size and appearance. (After Galezowski, Fig. 5.)

p. 457.

PLATE VII.





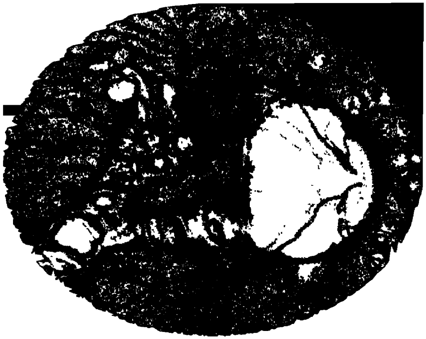


PLATE VII.

FIG. 1.—*Glaucomatous Excavation of the Optic Disc.*—The cup extends up to the edge of the disc. The disc is surrounded by a light ring, due to reflection of light from the anterior laminæ of the scleral ring. The dilated vessels, when they arrive at the margin of the disc, are seen to make an abrupt curve as they descend into the cup.

pp. 371, 372.

FIG. 2.—*Retinitis Pigmentosa*, or *Pigmentary Atrophy of the Retina and Choroid.*—The dingy mottling of the fundus arises from the irregular pigmentation of the choroid: where the pigment is scanty or absent, the choroidal vessels are exposed. The retina is atrophied, and towards the circumference are seen the black, spider-like pigment-masses which characterize the affection. The disc is whitish and the vessels dwindled.

pp. 416, 419.

FIG. 3.—*Partial Atrophy of the Retina and Choroid, after Retino-Choroiditis. Large Posterior Staphyloma.*—The optic nerve entrance is slightly reddened, and seen in an oblique projection, that is, as an oval disc, on account of the staphylomatous distension of the posterior scleral one. The staphyloma is shaped like a shell, tendinous in appearance, of a bluish colour, and graded almost like a miniature terrace. The border contains a great deal of pigment. Above and below, touching the staphyloma, there is a small roundish, pale-red mass of exudation. To the outer side of the scleral staphyloma are two groups, connected to each other, of ancient inflammatory centres, roundish in shape, and already advanced in atrophy, through which the sclerotica glimmers, and which appear mostly surrounded by a ridge of dark pigment. On the inner half of the fundus are numerous scattered small atrophying spots, surrounded by pigment, as well as some recent ones of a yellow colour. The whole fundus has a tesselated appearance. (After Stellwag von Carion.)

p. 385.

CHAPTER I.

Remarks on the Anatomy of the Eye—Mechanism of the Accommodation of the Eye.

ANATOMY OF THE EYE.

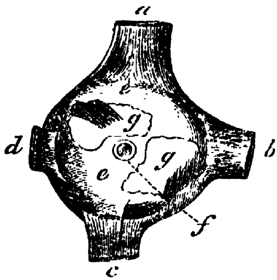
CAPSULE OF TENON.

Facilitates motion.

Preserved in extirpation of the eye.

Orbito-Ocular Sheath.—The eyeball is encased in a fibrous sheath, which commences at the apex of the orbit, and embracing the optic nerve, passes forwards and becomes interwoven with the sclerotic a few lines behind the margin of the cornea. This sheath is known as the orbito-ocular sheath, or capsule of Tenon; it is perforated by the tendons of the obliqui muscles near the equator of the eye, and anteriorly the tendons of the recti muscles, in passing through it, give off a number of fibres, which are incorporated into those of the capsule of Tenon; in fact, these muscles may be said to be inserted not only into the sclerotic, but also into the orbito-ocular sheath (Fig. 1). The posterior surface of the globe of the eye, therefore, glides over the inner layer of the capsule of Tenon, somewhat in the same way as the head of the femur does in the acetabulum, a small quantity of serous fluid intervening between the eyeball and the orbito-ocular sheath. In extirpation of the eye, care should be taken not to

FIG. 1.



a, *b*, *c*, *d*, sections of the recti muscles; *e*, *e*, capsule of Tenon; *g*, *g*, sclerotic, the capsule of Tenon having been removed; *f*, section of optic nerve.

injure the barrier formed by this fibrous membrane, the operation is thus rendered less dangerous than when the capsule of Tenon is cut through, and the contents of the orbit external to it are wounded, for inflammation may under these circumstances be set up among the soft tissues contained within the orbit, and be propagated backwards to the cranial cavity.*

Importance of, in operations for strabismus.

The connexion of the capsule of Tenon with the tendons of the recti muscles has an important bearing on the operation of tenotomy for the cure of diplopia. Evidently, if the tendons of the muscles only are divided close to their insertion into the sclerotic, the processes given off from them to the capsule of Tenon will prevent the tendons from suffering too great a retraction, and allow of their forming adhesions to the sclerotic near their normal point of insertion, often a matter of the first consideration in operations for the cure of strabismus.

Form of the eyeball.

If the eyeball is carefully separated from its attachments, it will be found to be nearly spherical; the cornea, being the segment of a smaller sphere, is more convex than any other portion. The eyeball varies in size in different individuals—its mean diameter being about seven-eighths of an inch.

THE SCLEROTIC.

The Sclerotic is the most external of the proper tunics of the eyeball, forming a dense, opaque, fibrous casing, which gives shape and support to the delicate structures within; its texture is modified anteriorly, where it forms the cornea, so as to become transparent and admit the passage of light to the interior of the eye. The optic nerve, ciliary vessels and nerves, pierce the sclerotic from behind: it is thickest posteriorly, where it corresponds to the situation of the retina, and becomes gradually thinner in front, until within a short distance of the cornea, when the sclerotic again increases in thickness, the capsule of Tenon being here fused into its substance: it is thinnest immediately behind the insertion of the recti and obliqui muscles. The sclerotic is in relation externally with the capsule of Tenon, and internally, in front, with the ciliary muscle, and behind with the choroid.

THE OPTIC NERVE.

The Optic Nerve passes through the sclerotic, together with the retinal vessels, at a spot about one-tenth of an inch internal to the antero-posterior axis of the eye. The passage through which the nerve enters the eyeball is funnel-shaped—being smaller towards the inner than the outer surface of the sclerotic: this opening is crossed by numerous decussating fibrous bands, which constitute the *lamina cribrosa*—in fact, it would be more correct to say that the sclerotic is pierced by a number of small openings for the transmission of the component fascicles of the nerve, rather than by a single one for the nerve itself.

---

* "Atlas of Surgical and Topographical Anatomy," by B. F. Beraud; translated by R. H. Holme, pl. 15, fig. 2.

Disposition of its sheath.

The optic nerve is encased in a dense fibrous sheath, a portion of which, on reaching the sclerotic, becomes fused into its structure, strengthening it posteriorly. In addition to this, the neurilemma of the various bundles of which the nerve is composed, is not prolonged into the eye, but quitting the nervous elements (which are further deprived of their white substance), it terminates in the fibrous meshes of the lamina cribrosa and anterior layers of the sclerotic.

Donders' views.

Donders* describes the sheath of the nerve as consisting of two parts; the larger, external portion, leaves the nerve as it is about to enter the eye, and passing outwards, becomes incorporated with the sclerotic; the inner, more delicate portion, follows the nerve as far as the lamina cribrosa, which it helps to form, and then bends outwards to join the sclerotic towards its inner surface. The two portions of the sheath, in the normal condition of the parts, are united by a thin intervening layer of connective tissue, but the interval between them is continuous with the arachnoid cavity; and in persons predisposed to the affection known as *staphyloma posticum*, the outer sheath diverges prematurely from the inner one, leaving a considerable interval between them, which in section appears triangular, and is occupied by an increased growth of connective tissue. In this condition of the parts, the sclerotic immediately around the optic disc is represented by the thin layer of the inner sheath, deprived of the support it usually receives from behind, and is therefore prone to yield to intraocular pressure giving rise to staphyloma (see Fig. 33).

Relation to Post. staphyloma.

---

* "Accommodation and Refraction of the Eye," by Donders, p. 378 (New Sydenham Society).

THE CONJUNCTIVA. *The Conjunctiva* is essentially a mucous membrane, composed of an external stratum of epithelial cells resting on a basement membrane, beneath which the capillary vessels are situated. It lines the eyelids, and is continued over the anterior part of the eyeball; in the former situation it is known as the tarsal or palpebral conjunctiva, and in the latter as the orbital, or ocular conjunctiva. At its line of reflection from the lids to the eyeball, the membrane forms a loose fold, called the tarso-orbital fold; at the inner angle of the eye is a vertical fold, the plica semilunaris.

Palpebral portion. The palpebral conjunctiva is extremely vascular and thick, and its free surface is elevated into numerous papillæ, each of which encloses one or more fine capillary loops, and a terminal nervous apparatus, the whole being encased in connective tissue. **Papillæ and glands.** Beneath the basement membrane is a loose connective tissue, in which a number of solitary glands are imbedded; and besides these, there are a row of some eighteen or twenty conglomerate glands, opening by as many ducts on the free surface of the tarso-orbital fold of the conjunctiva; they pour out an abundant watery secretion, which helps to lubricate the eye.

Ocular portion. The ocular conjunctiva is void of papillæ, and is bound down to the capsule of Tenon by connective tissue; anteriorly it is united with the sclerotic. **Its vascular supply.** It is supplied with a superficial and deep set of vessels, the former being derived from branches of the palpebral and lachrymal arteries, and the latter from the muscular and ciliary; these anastomose with one another, forming a zone of vessels round the circumference of the cornea, and from this circle small branches pierce the sclerotic and anastomose with the vessels of the iris and choroid. In consequence of this arrangement, **The "sclerotic zone."** when the latter structure is congested, the zone of vessels round the cornea becomes turgid also, forming the "sclerotic zone of vessels," the "arthritic ring" of which we shall have to speak so frequently, as a most important indication of disorder in the intra-ocular circulation.

Venous anastomoses. The veins of the conjunctiva empty themselves into the cavernous sinus through the muscular and lachrymal veins, and also into the angular vein of the face, by the nasal arch; so that if from any cause the passage of blood through the vasa vorticosa of the choroid into the ophthalmic vein is impeded, as in glaucoma, a collateral circulation is established through the veins of the conjunctiva—hence the enlarged and tortuous superficial vessels noticed in chronic diseases affecting the choroid.

The Cornea.

The Cornea is a modification of the sclerotic so constructed as to receive its nutriment by endosmosis, thus preventing the necessity for a vascular system, which would interfere with its transparency. The circumference is bevelled in such a manner that the sclerotic overlaps it; but, with this exception, it is of the same thickness throughout.

Its anterior lamina.

The cornea is divided into three laminæ; the external or conjunctival is an apparently structureless membrane, its anterior surface being covered by several layers of epithelial cells; posteriorly it sends processes inwards, interlacing with the fibrous elements of the lamina beneath it. The middle lamina constitutes the principal bulk of the cornea, and consists of fibrous tissue, so arranged as to form strata superimposed one over the other; frequent communications, however, exist between contiguous layers, so that they are intimately connected one with another. In the intervals between the bundles and layers are innumerable interspaces or fissures, which contain elongated branching cells and a nucleus; these cells are probably filled with nutrient fluid during life. Branches of the long ciliary nerves may be traced into the cornea, where they appear to form a very abundant and intricate network.

Middle lamina.

Internal lamina.

The internal lamina of the cornea is composed of an homogeneous membrane, and is lined internally—that is, towards the aqueous humour—by epithelial cells. Bowman describes it as "a transparent homogeneous membrane. Though very hard and capable of resisting pressure, giving a crisp sound when divided with scissors, yet it is very brittle and easily torn, fragments showing a remarkable tendency to curl up on all sides into rolls."*

Anatomical relations of internal lamina.

A part of the fibrous structure of the middle lamina unites with the internal at the circumference of the cornea, and their union gives rise to three sets of fibres; one passing backwards towards the ciliary processes, form a point of attachment for the ciliary muscle, another bending forwards in an arched manner, unite with those of the sclerotic, leaving a small space between the two, called the circular sinus; and a third set of these fibres curve backwards to the iris, and are inserted into its anterior circumference.

---

* "Lectures on the Parts concerned in the Operations on the Eye," by W. Bowman, p. 19.

THE CHOROID.

Structure and relations.

The Choroid is essentially a vascular structure, serving the primary purpose of a reservoir of blood for the nourishment of the vitreous and lens. It is prolonged anteriorly into the ciliary processes; externally it is in contact with the sclerotic and ciliary muscle, and internally with the elastic lamina of the choroid, a fine hyaloid membrane upon which the hexagonal cells of the choroid rest; these two limiting structures being united by bands of connective tissue, in the meshes of which are situated the vessels, nerves, contractile tissue, and pigment cells, which collectively constitute the choroid. The innermost layer of cells—that is, those nearest the elastic lamina—are almost devoid of colouring matter, and are very much smaller than the pigment cells. The choroid contains a considerable quantity of contractile tissue prolonged from the ciliary muscle. Its nerves are derived from the short ciliary branches of the ophthalmic ganglion.

Arrangement of its vessels and pigment cells.

The vessels of the choroid and ciliary processes have been divided by anatomists into several layers, which it is unnecessary for me to describe. The arteries are derived from the posterior short ciliary divisions of the ophthalmic artery, which, piercing the sclerotic near the lamina cribrosa, divide into numerous branches; these are directed forwards, following a somewhat meandering course among the pigment cells of the choroid, and they give origin to a dense capillary network situated immediately behind the elastic lamina.

Capillaries internal.

The larger vessels of the choroid, therefore, are nearer the sclerotic than their capillaries, and in their meshes are lodged the stellate pigment cells of the part; whereas many of the capillaries are internal to the pigment cells, and consequently when these vessels are congested, if the eye is examined with the ophthalmoscope, they will be found almost to conceal the larger vessels of the choroid and its pigmentary structures.

Hidden by pigment in dark races.

Among dark-skinned people, so long as the hexagonal cells of the elastic lamina remain *in situ*, it is impossible to see the choroid with the ophthalmoscope; but in the fairer races, the hexagonal cells being free from pigment allow the passage of light to the choroid, and the reflection from this vascular layer causes the scarlet colour of the fundus of the eye as seen with the ophthalmoscope.

Some of the branches of the short ciliary arteries pass forwards through the ciliary muscle, and enter the iris.

Veins "vasa vorticosa" external.

The veins of the choroid form a vascular stratum external to the arterial network; they are arranged in curves (vasa vorticosa), converging to four large branches, which perforate the sclerotic midway between the optic nerve and the cornea and ultimately empty themselves in the cavernous sinus.

Ciliary processes.

Beyond the ora serrata the inner surface of the choroid appears striated; anteriorly the striæ become deeper, forming the *ciliary processes*, which pass forward and overlap, but do not actually touch the edge of the lens. These processes, amounting to about sixty in number, are received into as many folds of the vitreous body: they are lined internally by the suspensory ligament of the lens; externally they are in contact with the ciliary muscle. The structure of the ciliary processes is similar to that of the choroid, but anteriorly the vessels bend round upon themselves, each process being formed, as it were, of a club-shaped mass of vessels imbedded in fibro-cellular tissue and pigment cells; these processes are situated immediately behind the iris, forming the ciliary body.

THE IRIS.

The Iris, as has been already stated, arises from the fibres proceeding from the margin of the inner lamina of the cornea, some of which may be traced into it. A second set, arising from the margin of the cornea, were mentioned as passing posteriorly towards the ciliary processes; some of these, too, may be followed into the iris. In addition to its fibrous structure, the iris contains an outer longitudinal and an inner circular set of contractile fibres, connective tissue, pigment cells, vessels and nerves. Its anterior surface is free, and bathed by the aqueous humour; its posterior surface rests against the capsule of the lens, and it inner margin forms the circumference of the pupil. It contains a vast number of pigment cells; those on its

Its attachments and structure.

posterior surface being continuous with the epithelium covering the elastic lamina of the ciliary processes.

Contractile elements.

The contractile (muscular) fibres of the iris may be divided into two sets; the outer, or radiating, which are described as running in fasciculi from without inwards, forming the dilatator pupillæ, and the internal circular fibres, which constitute the constrictor pupillæ.

Vessels.

The vessels of the iris pursue a similar course; they are of a small size, and are derived from the long ciliary arteries, which perforate the sclerotic posteriorly; they pass along in the ciliary muscle till they reach the outer margin of the iris, when they divide and form a zone round its circumference, sending off branches to the iris and ciliary muscle.

Nerves.

The iris derives its nerves from the ciliary branches of the ophthalmic ganglion, which connect it with the third, fifth, and sympathetic nerves, and also from the long ciliary branches of the nasal nerve; these uniting form a plexus round the outer margin of the iris, and from thence send off branches to supply the dilatator and constrictor muscles.

Reflex action of the pupil.

Motor fibres.

The contraction of the pupil, in obedience to the stimulus of light, is evidently a reflex action depending upon excitation of the retina, the impression being transmitted to the circular muscle of the iris through the third nerve; for it is through the action of the motor fibres of this nerve that the circular muscle of the iris contracts, for when the retina or the third nerve is destroyed the pupil remains dilated. If the optic nerve is divided, the iris still contracts when the portion of the nerve connected with the brain is irritated; and when the third nerve is divided, the irritation of its distal portion will still excite contraction of the iris. It is well known that through means of this reflex action, both irides will contract their pupils under the influence of light falling on one retina. Thus, in amaurosis of one eye, its pupil may contract when the other eye is exposed to a stronger light. The iris also contracts in association with certain other muscles supplied by the third nerve: thus, when the eye is directed inwards, or upwards, by the action of the recti, the iris contracts, as if under the action of the will; the contraction of the iris may under these circumstances occur in cases of total blindness. The contraction of the pupils, when the eyes are inverted as in looking at near objects, serves the purpose of excluding the extraneous rays of light which are too divergent to be refracted on the retina.* The sympathetic nerve brings the radiating fibres of the iris into action, and hence division of the sympathetic in the neck is followed by contraction of the pupil, whereas its irritation causes the pupil to dilate. Donders remarks, that the action of the sympathetic causes a persistent exaltation of the tone of the radiating fibres of the iris; thus the dilatator pupillæ is with constant force the antagonist of the sphincter muscle.† It seems very possible, however, that the sympathetic fibres in this, as in other situations, are chiefly distributed to the vessels, and unless by altering their calibre hardly influence the movements of the iris.

Sentient.

The fifth is the sentient nerve of the iris; its motor action can only be explained by supposing that, when irritated, reflex action takes place from the Gasserian ganglion, for its influence in causing contraction of the pupil continues after division of the oculo-motor and the sympathetic nerves.‡

THE RETINA.

Extent and relations.

The Retina is essentially a nervous structure, spread over the inner surface of the back of the eye. It extends from the optic disc forwards as far as the ora serrata, its posterior surface being in contact with the hexagonal cells of the choroid; internally it is separated from the hyaloid by the membrana limitans.

The central artery and vein.

The vessels of the retina are derived from the arteria centralis retinæ, which enters the eye through the centre of the lamina cribrosa, and passing through the optic disc, sends out branches in different directions; they form, however, two principal groups as they leave the disc—one ascending, the other descending. These vessels are at first situated immediately beneath the membrana limitans, but ultimately they dip down into the nervous elements of the retina, terminating in a system of delicate and by no means numerous capillaries. The veins commence in a circle round the ora serrata, and converging from thence, end in the vena centralis retinæ, which passes out of the eye through the centre of the optic disc.

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* "Handbook of Physiology." By W. T. Kirkes. Eighth Edition, p. 540.

† *Vide* Donders on "Accommodation and Refraction," published by the New Sydenham Society, p. 579.

‡ Id. p. 581.

Independent vessels of the disc.

The optic disc is described by Galezowski, Clifford Allbutt, and other authorities, as having a separate source from which it derives its blood-vessels, consisting of branches from the pia mater to the chiasma of the optic nerve, a branch from the middle cerebral to the optic tracts, as well as vessels from the choroid plexus and central artery of the retina: by means of the former (branches from the pia mater) there is an unbroken vascular network from the optic tracts to the papilla. In consequence of this arrangement, we can understand how anomalies in the cerebral circulation may extend to the papilla of the optic nerve, and how, from disease of the vessels supplying the papilla, this structure may be converted into a perfectly white disc (atrophy), its rose colour depending upon the supply of blood from the above-mentioned sources. On the other hand, the condition of the vessels of the optic papilla may indicate the degree of repletion or anæmia of the cerebral vessels, of which they are the prolongation.* But we must bear in mind that the blood supply of the disc is also maintained by vessels given off from the central artery of the retina, and from a vascular circle which surrounds the disc, formed from branches of the short ciliary arteries. In addition to these vessels the optic disc receives arteries and veins directly from the choroid, these anastomose with branches from the central vessels of the retina.

Intimate connexion with the brain.

The yellow spot.

A deeply-tinted yellow spot, called the *macula lutea*, may be observed in the retina, situated exactly in the axis of vision; it is therefore about the one-tenth of an inch to the outer side of the entrance of the optic nerve (optic disc); in its centre will be seen a small depression, the fovea centralis. The retinal vessels will be noticed curving above and below this spot in an arched manner, but they do not cross it. The macula lutea is the most sensitive part of the retina.

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* "Etude Ophthalmoscopique sur les Altérations du Nerf Optique," par X. Galezowski, p. 33, Paris, 1866; also "On the Use of the Ophthalmoscope," by T. Clifford Allbutt, p. 80, London, 1871.

Entrance of the optic nerve.

Scleral opening.

As I have already mentioned (p. 3) the fibrous sheath of the optic nerve is divided into two layers, the outer one being fused with and strengthening the posterior and middle layers of the sclerotic; and the internal sheath, which represents the neurilemma, passing forwards to the intra-ocular surface of the sclerotic to become fused with its anterior layers. Consequently, at the optic foramen of the sclerotic, a more or less projecting border is formed, to which the edge of the posterior opening of the choroid is attached by filamentary tissue. The scleral opening is filled by the anterior part of the optic nerve.

The lamina cribrosa is constituted by processes from the neurilemma of the optic nerve, strengthened by a network of elastic elements from the sheath of the central artery of the retina, and by fibres from the sclerotic.

LIGAMENT OF THE LENS.

The Suspensory Ligament of the Lens (zonula of Zinn) is a fibro-cellular structure internal to the hexagonal cells of the choroid; it passes forwards from the ora serrata and along the ciliary processes, and dipping down over the margin of the lens, it is incorporated with the anterior surface of the capsule of the lens. In leaving the ciliary body to pass to the lens, the suspensory ligament forms the anterior wall of the canal of Petit, to be presently noticed.

THE HYALOID AND VITREOUS.

The Hyaloid constitutes the membranous bag in which the Vitreous is contained; it is a most delicate and fragile structure, and is in immediate contact with the membrana limitans as far forwards as the ora serrata: anteriorly it is in apposition with the suspensory ligament of the lens, until, advancing close up to the margin of the lens, it dips down behind it, so that the edge of the lens is contained in a canal, first described by Petit, which is formed by the suspensory ligament in front and by the hyaloid behind.

Enclosed in this sac (the hyaloid) is the *Vitreous humour*, consisting of mucous tissue—the gelatinous connective tissue of Kölliker. It is structureless, without nerves or vessels, but contains nuclei and cells, which are principally found in its peripheral layers, and near the hyaloid. The nutrition of the vitreous is carried on through the vessels of the retina and choroid.

THE LENS.

The Lens is a transparent double-convex body, about the sixth of an inch thick, more curved behind than in front; it is composed of a numerous series of fibres, united so as to form plates or laminæ, having a very complex arrangement. It is contained in an elastic homogeneous capsule; on the posterior surface of the anterior capsule is a layer of polygonal cells, otherwise the capsule has no epithelium. The lens with its capsule may be said to rest posteriorly in the anterior part of the vitreous, the hyaloid intervening, and in front it is attached by the suspensory ligament to the ciliary processes, and is in contact with the posterior surface of the iris, and aqueous humour.

Capsule of lens.

THE CILIARY MUSCLE;

The last structure I have to notice is the *Ciliary Muscle;* it consists of two sets of smooth muscular fibres, one having a meridional direction, the other a circular course; the former arise from the point of junction of the cornea and sclerotic, and pass backwards beneath the sclerotic as far as the ora serrata; they are attached to the sclerotic. These bundles of muscular fibre have an intimate connexion with the connective tissue of the ciliary processes and choroid. The circular fibres of the ciliary muscle are chiefly found near the boundary of the iris, and are attached to the fibres proceeding from the inner layer of the cornea towards the iris.

Its connexions.

Vessels and nerves.

The source of the vessels supplying the ciliary muscle is the same as in the case of the iris. Its nerves are derived from the ciliary, naso-ciliary (a nerve of sensation), and also from the sympathetic; these unite and form an abundant plexus in the muscle; it is also supplied with ganglionic cells.

ANATOMY OF THE EYELIDS.

The Eyelids serve a most important function in protecting the eye. Their anatomy will be readily understood by reference to the diagram on the opposite page, after M. Moll, which represents a vertical section through the middle of the upper eyelid, treated with acetic acid, and magnified.*

The surface of the skin of the lid (A) is covered with fine hairs, and is continuous with the palpebral conjunctiva (18-18). The cilia (22, 23) emerge from about the centre of the free margin of the lids, their follicles extending backwards into the eyelid above the tarsal cartilage: several sebaceous glands open into each hair follicle. The centre of the lid is occupied by the palpebral portion of the orbicularis muscle (C), a small portion of it (21) [Horner's muscle] passing beneath the cilia; through these contractile fibres the duct of the Meibomian glands is seen to pass. The tarsal cartilage (E) is situated immediately beneath the conjunctiva, the levator palpebræ is attached to its upper border (17). The Meibomian glands (12) are imbedded in the tarsal cartilage, and open (19) near the inner margin of the edge of the lid.

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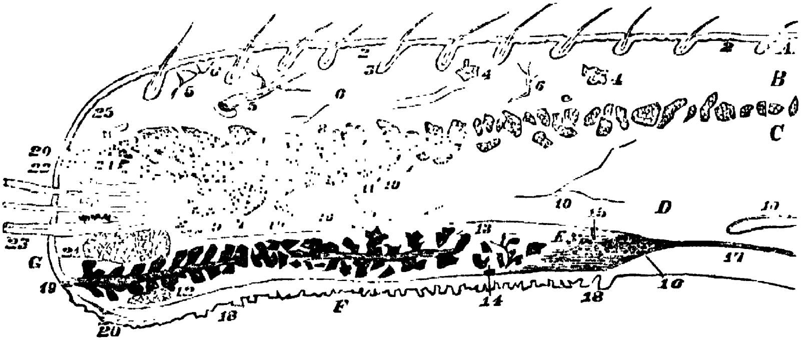
* "Archiv f. Ophth.," Bd. iii. p. 258. 1857; and H. Power, "Illustrations of Diseases of the Eye," p. 84, 1867.

FIG. 2.



Section of Eyelid.—After Moll.

A. External skin. B. Subcutaneous connective tissue.
C. Palpebral part of the musc. orbicularis.
D. Connective tissue containing fat between the orbicularis and the tarsus.
E. The tarsal cartilage. F. Mucous membrane.
G. Free border of the lid.
1. Epidermis. 2. Cutis, with papillæ.
3. Hairs with their follicles. 4. Sweat glands.
5. Bloodvessels in the subcutaneous connective tissue.
6. Nerves in the same.
7. Pars ciliaris } of the musc. orbicularis.
8. Pars palpebralis }
9. Fat.
10. Bloodvessels in the connective tissue between the musc. orbicularis and the tarsus.
11. Nerves in the same.
12. Lobuli of the Meibomian glands.

13. Termination of the same glands.
14. Section of an adjoining Meibomian gland.
15. Adipose tissue in the most superior part of the tarsus over the ends of the Meibomian glands.
16. Elastic tissue merging into the upper part of the tarsus.
17. Musculus levator palpebræ superioris, terminating in the above-named elastic tissue.
18. Papillæ of the mucous membrane.
19. Opening of the excretory duct of the Meibomian follicle.
20. Glands of small hairs near the free border of the lid.
21. Tarsal portion of the orbicularis (Horner's muscle).
22. Cilia. 23. Two cilia in one follicle.
24. Sebaceous glands of the cilia.
25. Cutis of the free border of the lid.

THE ACCOMMODATION OF THE EYE.

Accommodation of the Eye.

The Accommodation of the Eye—that is, the mechanism by which rays of light from objects at different distances are brought to a focus on the retina, has been a matter of dispute for years; and the subject has acquired additional interest from the large share of attention which has of late been directed to the disorders of accommodation.

Due to changes of curvature in the lens.

It will be advisable, in the first place, to glance at the facts which appear to prove that, in the accommodation of the eye for near objects, the convexity of the anterior surface of the lens is increased. It is evident that this, or some equivalent change in the dioptric media of the eye, must take place, otherwise rays of light from a near object (divergent rays) could not possibly be brought to a focus on the retina, upon which rays from distant objects (parallel rays) are also focussed; in other words, parallel and divergent rays cannot be brought to the same focus, unless the refracting medium through which they pass is capable of altering its power of refraction.

The necessary adjustment for the accommodation of the eye might be brought about by changes in the curvature of the cornea, or else by an elongation and contraction of the antero-posterior axis of the eyeball; it would seem, however, as if Cramer and Helmholtz had settled the matter in favour of an alteration in the curvature of the lens as the cause of the necessary changes in the dioptric media.

The experiments of Helmholtz.

Helmholtz, in his experiments, took advantage of the well-known fact that when a lighted candle is held in front of a healthy eye, three reflected images of the flame may be seen apparently in the pupil—an anterior and posterior erect image, being the reflections from the cornea and anterior surface of the lens, and a middle but inverted image reflected from the posterior surface of the lens or vitreous. With his ophthalmometer he was able to measure the magnitude of these reflected images under varying circumstances, and he found that so long as the person under observation looked steadily at a distant object—that is, accommodated his eye for the far point—the three reflected figures of the flame of the candle remained unaltered in size; but the instant the accommodation of the eye was changed, and a near object was brought under observation, the reflected image from the anterior surface of the lens increased in magnitude, the other figures remaining unaltered in size.

Changes of curvature demonstrated.

It became evident, therefore, that in varying the accommodation of the eye from a far to a near object, the convexity of the anterior surface of the lens was augmented, the depth of the lens from before backwards being increased by the bulging forwards of its anterior surface. The increase thus observed in the curvature of the lens, has been shown, mathematically, to be sufficient to bring divergent rays from near objects to the same focus as that of parallel rays from distant objects without such alteration. In the latter case the lens is at rest, and it is only when we look at near objects that the accommodation is brought into play.

The same conclusion, as to the nature of the changes which occur in the adaptation of the eye to vision at different distances, has been arrived at in other ways; but the above experiments are sufficient for our present purpose.

Accommodation a voluntary act.

The accommodation of the eye appears to be a voluntary act, inasmuch as it is under the control of the will: we wish to see a near object, and on looking at it, the changes in the form of the lens above described take place, in the same way as the extensor muscles respond to the desire to open our hand when closed. In the infant we see how vague and uncertain the performance of those actions is, which for accuracy depend upon the accommodation of the eye; doubtless by repetition these actions afterwards become unconscious and automatic; the acquired faculties being organized in the constitution of the sensori-motor ganglionic nuclei, the movements follow as reflex effects of an external stimulus. Another point especially deserving attention in connexion with these focal adjustments, is the combined precision and incessant variation required: so long as a person is awake, alterations in the distance between the retina and objects under observation must be taking place at every instant, necessitating corresponding alterations in the curvature of the lens; for it has been proved that, for correct vision, not only must the rays of light be brought to a focus on the retina, but they must be accurately focussed on its bacillary layer.

Focal adjustments.

Attributed to the ciliary muscle.

The highest authorities of the day hold, that the accommodation of the eye is effected by the action of the ciliary muscle. Donders says—"It therefore remains only to attribute to the musculus ciliaris the important quality of accommodation muscle. But the mechanism whereby the contraction of this little muscle alters the form of the lens, to however small a compass the question may now be reduced, is not yet satisfactorily or convincingly brought to light."*

In support of this idea we cannot overlook the fact that in those animals whose range of accommodation is highest, as birds, the ciliary muscle is largely developed; in those, as fishes, in which accommodation is almost *nil*, the ciliary muscle is hardly developed.

At one time it was supposed, that in the accommodation of the eye the action of the ciliary muscle was much assisted by the iris; but Von Graefe's case has settled this point; for in this instance, the whole of the iris was removed and yet the focus of accommodation remained perfect.

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* "Accommodation and Refraction of the Eye," by Donders, p. 26 (New Sydenham Society).

CHAPTER II.

Methods employed in examining the Eye, and testing the patient's Vision — The Ophthalmoscope: its Principle and Use—Ophthalmoscopic Appearances of the Healthy Eye.

EXAMINATION OF THE EYE.

EXAMINATION OF THE EYE.

Light.

THE first and most essential point to attend to in examining the eye is, that it should be illuminated by a clear, bright light. The patient may conveniently be seated before a window, the surgeon standing in such a position, that no part of his person intercepts the rays of light from falling directly on the patient's eye, and yet enabling him to examine the part thoroughly.

Manipulation.

The next thing to be done is to open the eyelids, the upper one with the thumb of one hand, and the lower with the other. This manipulation, though simple enough, requires care; even slight pressure on the diseased eyeball frequently causing pain and irritation, followed by a gush of tears from the eye, which for the moment prevents us from proceeding with our examination. The lids having been separated as far as possible, the condition of the cilia, puncta, conjunctiva, sclerotic, cornea, and iris should be carefully noticed.

The two eyes to be compared.

If one eye only is diseased we must compare its condition with the sound eye; slight alterations in the colour and brightness of the iris, which may nevertheless be very significant, are often thus distinguishable, and any abnormal prominence or flattening of one cornea will be made more apparent by contrast with the other. It is, moreover, by a comparative examination of this kind, that we ascertain the nature of the various derangements that are met with in connexion with the muscular apparatus and movements of the eyeball.

Measurement of strabismus.

The degree of diplopia, or squint, existing in any particular case may be obtained by directing the patient to look at a distant object in front of him, and then making a mark on the lid opposite to the centre of the pupil of the squinting eye; if now the working eye be closed, and the patient still directed to look at the distant object, the squinting eye will move outwards so as to fix the object under observation, and another mark must then be made on the lid below the pupil; the distance between the first and second dots will measure the angle of squinting.

Activity of the pupil.

Examination of the Iris.—It will frequently be necessary in examining the diseased eye, to ascertain if the iris responds to the stimulus of light, or in other words, if the pupil dilates and contracts freely. To determine this, the patient should be placed before a moderately strong light, which falls obliquely, from one side only, on the eye. The unaffected eye should be closed with a folded cloth or the hand, so that no light can reach it. The surgeon then places himself in such a position, that while he throws a very dark shadow on the uncovered eye with his hand, he keeps the pupil well in sight. Fixing his eye on the edge of the pupil he quickly removes his hand so as to allow a bright light to fall on the eye, and then the eye is again shaded, and so on. If the iris be healthy the pupils will have dilated while the light was shaded from the eye, but will contract again the instant that luminous rays reach the retina. Any deviations from this rule should be carefully noticed, for, in the absence of synechia or other mechanical impediment to the motions of the iris, the character of its response to luminous impressions afford us valuable information in many disorders affecting the deep-seated structures of the eye. The retina may, however, be extensively diseased and yet the pupils dilate and contract on the stimulus of light, for as I have before remarked, light falling on the retina of a healthy eye will through reflex action cause the contraction of the iris in the other eye, although it be amaurotic; and, on the other hand, an inactive and dilated pupil does not by any means invariably indicate a diseased condition of the retina. In all doubtful cases it is advisable to apply a weak solution of atropine to the eye, the existence of synechia are demonstrated in this way, the affected pupil dilating in

Value of its indications.

Use of atropine.

an irregular manner. But supposing there are no such complications, the atropine will nevertheless be useful, enabling us the better to examine the deeper structures of the eye with the ophthalmoscope.

Examination of the lids.

Eyelids and Lachrymal Apparatus.—It is by no means an uncommon circumstance for foreign bodies to become lodged beneath the upper lid, and in order to see them it is necessary to evert the lid. A steel probe, or some such blunt instrument which will not easily bend, is laid against the skin of the lid along the upper border of the tarsal cartilage, or about half an inch from the free margin of the lid; the surgeon, with the other hand, takes hold of some of the most prominent cilia, and after gently drawing the lid forward, turns it backwards over the probe; if the patient be now directed to look downwards, the whole of the superior palpebral conjunctiva may be examined.

Mode of everting them.

Lachrymal obstructions.

The condition of the passages by which the lachrymal secretion passes from the eye into the nose often requires investigation, for should they become occluded, it is evident that the tears will be unable to escape through their proper channel, and accumulating at the inner corner of the eye will overflow and run down the cheek. Under these circumstances an idea may be gained of the seat of the obstruction from the following considerations:—If the puncta and canaliculi are healthy, gentle pressure made over the lachrymal sac will cause a minute drop of fluid to ooze out through the puncta; but supposing these structures to be impervious, no such regurgitation of fluid can take place. If therefore constant lachrymation exists, and on making pressure below the tendon of the orbicularis, a drop of fluid oozes out through the puncta, we may conclude that the obstruction is in the nasal duct.

Situation ascertained.

Displacement of the puncta.

There are, however, exceptions to this rule, for if the lachrymation depends on malposition of the puncta, either from chronic inflammation and thickening of the conjunctiva, from paralysis of the orbicularis, or any other cause slightly displacing the puncta, it is evident that only a portion of the tears can gain access to the sac, the remainder flowing over the cheek. Under these circumstances, the lachrymal sac being partly full, if pressure is made over it, a drop of fluid will ooze out through the puncta; but in such cases there can be no difficulty in ascertaining the cause of the overflow, the displacement of the puncta being readily detected by simple inspection.

Exploration by probe.

If we have reason to suppose that either the puncta or canaliculi are closed, we may explore the parts by introducing a fine probe into the punctum, and passing it along the canaliculus into the lachrymal sac. This is an easy matter if the parts are healthy, but if obstructed, we shall be unable to push the instrument beyond the point of stricture. In this operation the lid should be slightly everted, so as to expose the punctum, and a fine probe should be passed into it for about half a line in a perpendicular direction, the instrument being afterwards directed horizontally inwards towards the lachrymal sac. Care should be taken in passing the probe, as the mucous membrane lining the canal is a very delicate structure, which may readily be torn or injured, and a permanent stricture of the canal result.

Caution required.

Some slight resistance to the passage of the probe is often felt at one or both extremities of the canaliculus; this arises from the presence of two small valves, and the involuntary contraction of the sphincter muscle which surrounds the orifices of the duct. Gentle, but continued pressure with the probe, in the direction above indicated, will speedily overcome the spasm of these contractile fibres, and the instrument will then readily enter the sac, and its point may be pushed against the inner bony wall.

Tension of the eyeball.

Tension of the Eyeball.—The patient should be directed to close the lids of the eye under examination; the surgeon then places the tip of one forefinger on the outer part of the eyeball, exerting gentle pressure on the opposite side of the globe with the forefinger of the other hand; the amount of resistance offered indicates the degree of tension. In its healthy state the globe can be easily dimpled, but in chronic glaucoma it becomes of stony hardness. Mr. Bowman remarks:*—

Bowman's scale and register.

"I have found it possible and practically useful to distinguish nine degrees of tension, and for convenience and accuracy of note taking have designated them by special signs. The degrees may be thus exhibited:

"T represents tension, T N tension normal; the interrogation (?) marks a doubt, which in such matters we must often be content with; the numerals following the letter T on the same line, with or without the sign +, indicate the degree of increased tension; or if the letter T be followed by —, of diminished tension.

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* "British Medical Journal," 1862, vol, ii. p. 378.

"It is also to be borne in mind that the normal tension has a certain range or variety in persons of different age, build, temperament, and according to varying temporary states of the system as regards emptiness and repletion."

Test types.

Test Types.—It has been found advantageous to have a fixed scale by which to test the acuteness of vision, and which may be used not only as a standard of comparison between one person and another, but also to ascertain whether a patient's sight be improving or otherwise under treatment. Snellen's test types are now commonly employed for this purpose.* A series of these types from No. I. to No. XX. are arranged according to the size of the letters, so that No. I. is seen by a normal eye at a distance of one foot at an angle of five minutes, and its letters cannot be distinctly made out beyond that distance. The letters of No. II. are seen at two feet distance at the same angle, and so on, up to No. XX.

Snellen's types.

Method of using them.

Supposing now a patient to be affected with a defect of vision, so that he cannot see No. I. type at a distance of twelve inches from his eyes, but can make out No. IV. type at this distance; evidently he requires to see the letters under a larger angle than that of five minutes, in order that he may gain a larger retinal image. We calculate the degree of acuteness of vision as follows:—

V = Acuteness of vision.
d = utmost distance at which the type is recognised.
D = distance at which type appears at an angle of five minutes.

$$\text{Then } V = \frac{d}{D}.$$

For instance, the individual who, having his eyes properly accommodated, distinguishes No. XX. test type only at ten feet, instead of twenty feet, has diminished acuteness of vision,

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* Various forms of test types may be obtained from Messrs. Williams and Norgate, Henrietta Street, Covent Garden, London.

$$V = \frac{10}{20} = \frac{1}{2}.$$

If he can only distinguish No. III. type at one foot, his acuteness of vision $V = \frac{1}{3}$, and so on.

Range of accommodation.

The range of accommodation for vision at different distances varies in different individuals and at different periods of life; in the normal or emmetropic eye, the nearest point of distinct vision is from three and a half to four inches, and the furthest point is at an infinite distance, being limited only by the loss of the rays of light, due to atmospherical or physical causes.

Visual field.

The Visual Field.—The visual powers may be almost perfect at the macula lutea, and yet beyond this spot the functions of the retina may be completely destroyed. It is often necessary, therefore, to ascertain the extent of the visual field—that is, of the integrity or otherwise of the whole of the sentient surface of the retina.

Limits ascertained.

The limitation of the visual field may be ascertained in the following manner. The patient is seated at a distance of a foot from a blackboard, or a frame in which has been placed a sheet of blue tissue or other paper. On the centre of this a small cross is marked with chalk or pencil, and the patient is directed to fix his eye upon this point, the other eye being closed. The crayon is now moved over the paper, being carried successively upwards, downwards, and to the right and left horizontally, marking in each direction the extreme limits at which the patient perceives it. The same plan is followed for all intermediate points, and the outline thus drawn upon the board or paper shows the limit of the field of visual perception. The other eye may then be tested in the same way.*

A good idea of the extent of the visual field may be obtained by directing the patient to close one eye, and with the other to look steadily at one of the observer's eyes. While the patient keeps his eye fixed in this way, the observer moves one of his hands in various directions over the patient's field of vision, ascertaining how far the hand can be seen from the optic axis of the eye under observation. It is evident that under these circumstances, if the functions of any part of the retina external to the macula lutea is impaired, that the patient will be unable to see the observer's fingers when situated at the corresponding part of the visual field.

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* "Recent Advances in Ophthalmic Surgery," by Dr. Williams of Boston, U.S., p. 30.

Another method.

If the patient's sight is so far impaired that he can no longer count fingers, it may yet be necessary to test the extent of the field of vision, which may be managed as follows. One eye being closed, a white disc may be moved over the surface of the blackboard, and the point at which the patient recognises the object should be marked on the board; or the uplifted hand may be held at a distance of a foot from the patient's face, and having directed him to look towards it, a lighted candle is to be held in different positions in the visual field, and the spots noted at which it can be seen.

THE OPHTHALMOSCOPE.

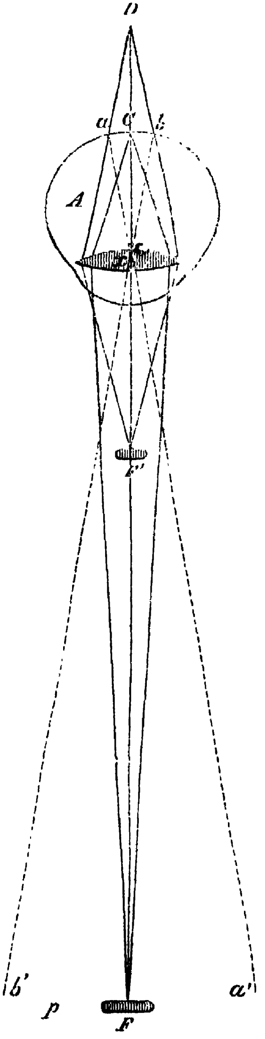
THE OPHTHALMOSCOPE.

The ophthalmoscope is now in such constant use as a means of exploring the condition of the deeper structures of the eye, that I need not dilate on the advantages it offers in the investigation of affections of those parts, which were formerly very obscure.

Its principle and use.

Illumination of the Eye.—The reason why we cannot ordinarily see the interior of the eye without the aid of such an instrument, as well as the principle of its action, will both become intelligible by reference to the following figure (Fig. 3), in which A represents the eye under examination, accommodated to the distant point F, where the flame of a lamp is supposed to be situated. It is evident that some of the divergent rays, proceeding from the luminous body at F, will fall upon A's cornea, and being refracted by its dioptric media, they will meet at C on A's retina. Some of these rays are absorbed, others are reflected by the structures of the fundus, and these, before emerging from the eye, must pass through precisely the same media as they did on entering it; and in consequence of their pursuing this path, they will be brought to a focus at the point from which they started—namely, at F. Unless an observer's eye, therefore, can be made to take the place of the lumi-

FIG. 3.



Why the pupil appears black.

nous body at F, it is evident that none of the reflected light from A's retina can possibly reach the observer's. A's pupil, therefore, appears black to a person in the position *p*, or, in fact, at any other point than at F.* If, however, a mirror with a hole in its centre, through which light can pass, be substituted for the lamp, and the rays reflected from its surface be directed into the eye A, the light returning from A's retina can now enter the observer's eye, which, under these circumstances, may be made to occupy the position of the lamp, as represented in Fig. 3.

Illumination by a perforated mirror.

Again, suppose the luminous body is removed from the point F to F′ (the patient's eye being still accommodated for the distance A F), the divergent rays proceeding from it, and being refracted by the dioptric media of A, would intersect at D, were they not intercepted by the fundus of the eye; as it is, they form a circle of light extending from *a* to *b*. But since the eye A is adjusted for the far point F, and not for F′, it follows, that the rays reflected from any point in the circle *a b*, after emerging again from A, will be brought to a focus at the distance A F; and those from the extreme points *a* and *b* will converge respectively to *a′* and *b′* in lines prolonged from *a* and *b* through *x* the optical centre of A. Under these circumstances, an observer's eye at any point *p* will receive a few of the rays from A's retina, which will thus appear illuminated, even without the aid of a mirror.

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* "Manual of Instructions for the Guidance of Army Surgeons in Testing the Range and Quality of Vision." By Deputy Inspector-General J. Longmore, Professor of Military Surgery at the Army Medical School. Page 38.

If these considerations be applied to the ophthalmoscope, the principles upon which this instrument depends as a means of illumination, may be readily comprehended, it being essentially a mirror, constructed so as to allow the observer's eye to take the place of the flame of the lamp, as represented in Fig. 4. As, however, the deeper parts of the eye are only seen through its refracting media, we have still to explain the formation of images of those parts, which may be distinctly visible to the observer.

Formation of images.

Formation of Images.—There are two distinct modes of examining an eye with the ophthalmoscope, known as the direct and the indirect methods. By the former an erect geometrical image is perceived by the observer, and by the latter an inverted aerial image is produced.

1. Direct method.

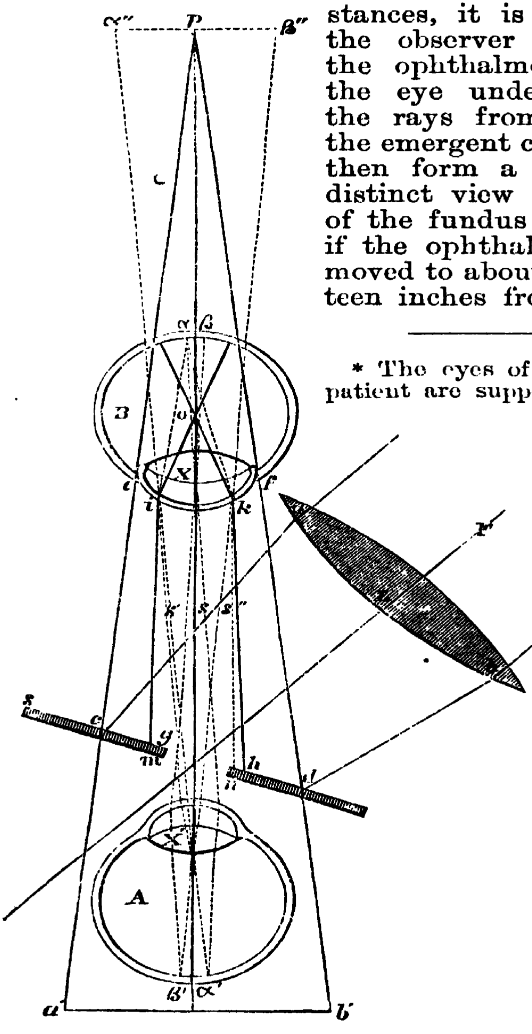
1. By referring to Fig. 4, the *direct method of examination* may be readily understood. A represents the eye of the observer, and B that of the patient, F the source of light, from which a cone of rays *a b* falls upon L, a double-convex lens interposed between F and the plane polished surface *c d* of the ophthalmoscope S. By means of the lens L the divergent rays of light from F are made to converge upon the mirror (which thus acts as a concave mirror in a position posterior to the eye of the observer), and after reflection from its surface, they proceed as if they came from *a′ b′* situated behind it, and converge towards some point *p*. A portion, however, of the rays included between *g i* and *h k* is intercepted by the dioptric media of B, and these, after refraction, intersect at O within the eye, from whence they again diverge to form a circle of light upon B's retina. If in this circle any two points α, β, be taken, the reflected rays from which pass through the sight-hole *m n* of the ophthalmoscope, they will be brought to a focus at α' and β' on A's retina, and a virtual, erect, and magnified image $\alpha'' \beta''$ of $\alpha \beta$

Image erect, magnified.

will be seen by the observer, apparently projected beyond the patient's eye.*

To obtain a clear view of the retina under these circumstances, it is necessary that the observer should advance the ophthalmoscope close to the eye under examination; the rays from the centre of the emergent cone of light will then form a large and very distinct view of minute parts of the fundus of the eye; but if the ophthalmoscope be removed to about twelve or fourteen inches from the patient's

FIG. 4.



(From Carter's translation of *Zander*.)

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* The eyes of both observer and patient are supposed to be emmetropic, that is, a clear and distinct image of an object is seen at ordinary visual distances. The magnification of the image in this case is so far a defect, that it loses in brightness and definition as it gains in size, and therefore contrasts unfavourably with the bright, sharp, beautiful image which the indirect method displays. Throughout the following work, *Coccius's* ophthalmoscope is supposed to be the instrument employed in making observations, unless, as in some few cases, special reference is made to another form of ophthalmoscope.

eye, the outer rays of the cone will pass through the sight-hole of the instrument together with the central ones, and the vessels or any other spot on the retina will appear indistinct.

Inconvenient proximity of surgeon and patient.

The inconvenience of the surgeon being obliged to keep his face within a few inches of that of his patient during a prolonged examination may be overcome by the interposition of a concave lens between the eye of the patient and the ophthalmoscope, the effect of which is to render the light, after emerging from the eye, divergent, and the outer rays of the cone will then fall on the surface of the mirror, in place of passing through the sight-hole of the instrument.

Corrected by a concave lens.

If then the direct method of examination be employed in the examination of an *emmetropic* eye, as in the instance we have supposed, an erect image of the retina may be clearly defined at a distance of three or four inches, but only a very imperfect one can be seen at fourteen or fifteen. The case, however, is different where the refracting power of the eye is abnormal; thus,

Available in myopia and hypermetropia.

In the *myopic* eye, an erect image cannot be seen at all, but at about fourteen inches a well-defined inverted figure may be observed.

In the *hypermetropic* eye an erect image of the retina may be seen at a distance of fourteen or fifteen inches.* (See Chapter XV.)

2. Indirect method.

2. We may now proceed to make a few observations in explanation of the *indirect* method of ophthalmoscopic examination.

Using a convex lens.

The position of the patient, the lamp, and the ophthalmoscope should be the same as in the direct process, but, in addition, it will be necessary to place a convex lens in front of the patient's eye. In Fig. 5, A represents the observer's eye, B that of the patient, F the source of light, L′ a convex lens, by which a cone

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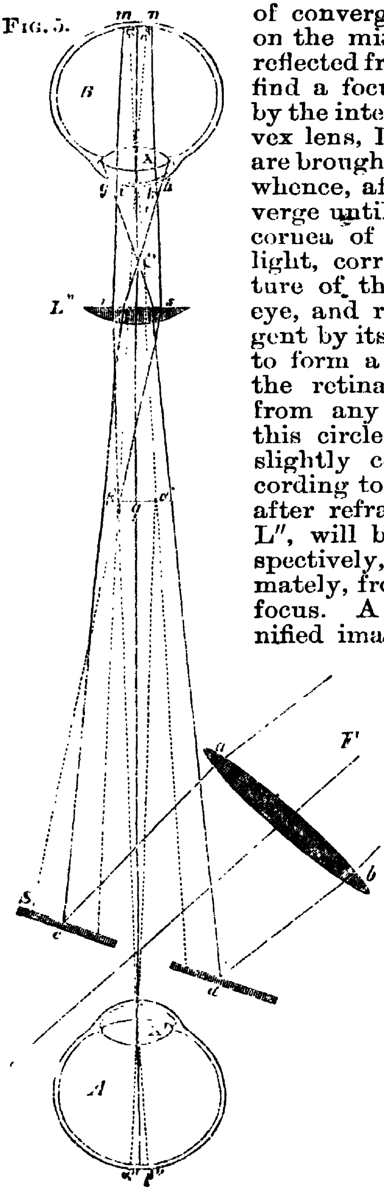
* An eye is said to be *myopic* when the converging power of the dioptric media is greater than in the normal state, and in consequence the focal point of parallel rays is situated in front of the retina, diverging rays only being brought to a focus on the retina. *Hypermetropia* is the reverse of myopia, the parallel rays of light being brought to a focus behind the retina, convergent rays only being focussed on the retina. In these, and in all subsequent instances, it is supposed that the observer's eye is *emmetropic*, or that by means of suitable glasses both divergent and parallel rays of light are brought to a focus on his retina.

FIG. 5.



of converging rays is made to fall on the mirror S, and which, being reflected from its surface, *c d*, would find a focus at some point *o*; but by the interposition of a second convex lens, L'' (object lens), the rays are brought to an earlier focus at *p*, whence, after intersection, they diverge until intercepted by *g h*, the cornea of B. A portion of this light, corresponding to the aperture of the pupil *i k*, enters the eye, and rendered slightly convergent by its dioptric media, proceeds to form a circle of light *m n* on the retina. The rays, returning from any two points α and β in this circle will emerge parallel, or slightly convergent from B (according to its accommodation), and after refraction by the object lens L'', will be united at α' and β' respectively, at the distance, approximately, from L'' of *q* its principal focus. A real, inverted, and magnified image α' β,' of α β, will thus be formed; and this will be distinctly visible by A at a distance of twelve or fourteen inches, the rays diverging from α' being brought to a focus on the retina at α'', and those from β' at β''.

Image inverted.

Mr. Carter explains the phenomena of the inverted and aerial image, under these circumstances, as follows:—

Explanation.

"If you hold up your ophthalmoscope lens, at a distance of about eighteen inches from your eye, and look through it at any distant object, you will see an inverted image of that object. The image appears to you to be painted on the lens, but it is really suspended in the air, nearer to you than the lens by the focal length of the latter. You can test this by a simple experiment. Take a printed page, move it slowly towards one eye, the other being closed, until the letters begin to be indistinct. Measure the distance between the eye and the page at which this indistinctness commences, and let us suppose that it is eight inches. Then get the inverted image again, move the lens slowly towards the eye, and measure the distance between the two at which the image begins to be indistinct. This distance will be eight inches, *plus* the focal length of the lens. If it be a two-inch lens, the distance will be ten inches; if a three inch, eleven inches,—thus showing that the inverted image advances in front of the lens, and comes to within eight inches of the eye, while the lens is still at a greater distance away."

By the indirect method of examination—

More convenient.

1*st.*—A clear and distinct image of a vessel, or any other small object on the retina, may be seen at a distance of twelve or fourteen inches.

Field larger.

2*nd.*—Although the magnification is less than by the direct method, the field of view is larger, and a considerable portion of the fundus of the eye being visible at once, its several parts may be studied and compared in their relative positions at a glance.

Ophthalmoscope of Coccius.

Choice of Instruments.—With regard to the form of ophthalmoscope for ordinary purposes, the one invented by Coccius is a very useful one. It consists of a small metallic surface coated with silver; in its centre is a funnel-shaped hole about the one-sixteenth of an inch in diameter, and a plate of blackened metal is made to slide upon the grooved edge of the mirror, by means of which the illuminating power of the instrument may be lessened if necessary. Attached to the slide is a clamp, into which a lens may be fitted in order to concentrate the rays of light upon the mirror; or it may be turned behind the sight-hole of the ophthalmoscope. Various lenses are supplied in the case, to be used as object-glasses. This instrument is equally useful either for the direct or indirect methods of examination.

LIEBREICH'S ophthalmoscope.

On the whole, I believe that Liebreich's small ophthalmoscope is preferable to all other instruments of the kind; it consists of a circular, concave, metallic mirror, of four-inch focal length, having in its centre a funnel-shaped sight-hole. Attached to the mirror is a clamp, by which one of the ocular lenses, to be found in the instrument case, being placed in the clip, may be adjusted behind the mirror. Object lenses are also supplied which are intended to be held before the patient's eye.

In place of the clamp behind the mirror, Dr. Noyes's ophthalmoscope is provided with a revolving disc, in which four convex and the same number of concave lenses are placed, which may thus successively be conveniently brought in front of the sight-hole of the instrument.

Binocular instrument.

The binocular principle has been applied successfully to ophthalmoscopy; and without entering upon a detailed description of the construction of this instrument, I may recommend Heath and Murray's binocular ophthalmoscope to those, who feel disposed to use a complex, rather than one of the more simple instruments above referred to.

BEALE'S ophthalmoscope.

Self-illuminating Ophthalmoscope.—This instrument is the invention of Dr. Lionel Beale, and consists of two brass tubes sliding within each other. At the extremity of one of these tubes a block of wood shaped to the orbit is inserted, while to the side of the other a lamp is fixed. The inner part of the cylinder carries a reflector and the ordinary ophthalmoscope lens. The ophthalmoscope can be held in the hand or may be mounted upon a stem, and as the eye is examined in a manner similar to that of looking through a telescope, it can be used in any room in full daylight or when lamps are lighted. This arrangement obviates the necessity of a dark room for ophthalmoscopic investigations. It can also be used irrespective of the patient's position, being equally applicable to the standing or recumbent posture. It has extra lenses so as to be able to form an otoscope, endoscope, or laryngoscope.*

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* Dobell's "Reports on the Progress of Medicine" for 1870, p. 508.

Having made choice of an ophthalmoscope, our next inquiry must be as to the source of light most readily available, and best suited for ophthalmoscopic purposes.

Source of light.

In places where gas is available, a round full flame from a gas lamp, will probably afford the best source from which to obtain light to throw into the eye for ophthalmoscopic purposes; but in many instances we cannot procure light from a gas burner, and under these circumstances a kerosine lamp may be used with advantage; it gives a remarkably good light; the flame is steady, white, and clear, and the wick seldom requires to be trimmed.

Atropine not essential.

It is not always necessary to dilate the pupil with atropine before making an ophthalmoscopic examination; a general idea of the fundus of the eye may be gained without the use of any mydriatic. The patient should be desired to look attentively at a mark on the opposite wall of the room, so that his eye may be accommodated for a distant point; if now he close one eye, the pupil of the other will dilate sufficiently to allow of an ophthalmoscopic examination. Should it be found necessary to make a more perfect observation, a solution of atropine may be applied to the eye, of a strength not exceeding one grain to an ounce of water. A patient is often put to considerable inconvenience if a more powerful mydriatic be used, the pupil taking several days to contract; and to a man engaged in business, this is a matter of consideration, for so long as the effects of the atropine remain, he will experience difficulty in reading and writing.

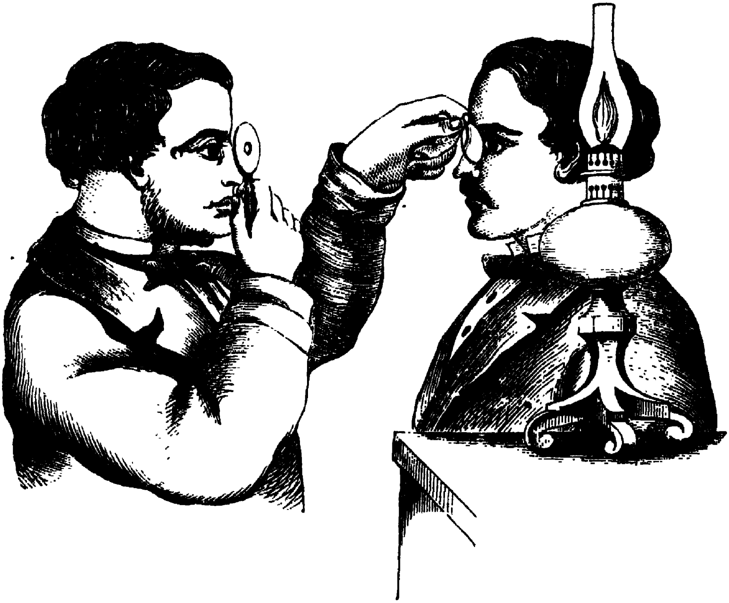
A weak solution to be used.

It may be well to remind the reader that except in cases where one eye only is diseased, and the abnormal conditions are clearly and unmistakably apparent, a prognosis should not be ventured on until both eyes have been examined, the state of the one being carefully compared with that of the other. Nothing is so likely to damage one's reputation, or to shake the confidence of our patients in our judgment and skill, as giving a hasty or ill-considered opinion, which on a subsequent examination it may be found necessary to alter: for this reason, also, it is advisable to write down the appearances presented by the eye in a notebook, with which to refresh our memory, and enable

The two eyes to be compared.

us to form an idea of the progress of the disease, if at any subsequent period the patient present himself for inspection.

FIG. 6.



The inverted image.

Examination of the actual inverted image.—The arrangement of the lamp, the patient, and the observer, when artificial light is employed, is shown in Fig. 6. It will be noticed that the eye of the surgeon, that of the patient, and the source of light are upon the same level, the lamp being placed close to, and a little behind the ear of the latter. An assistant should stand behind the observer, holding a large white card, or some such conspicuous object, in his hand, upon which the patient is directed to fix his eyes. If the right eye is under examination, the card must be held over the observer's right shoulder, and for the left one, over the left. By this means the patient's eye is inclined slightly inwards, and the rays of light from the ophthalmoscope will fall directly upon the optic disc.

Position of patient and observer.

Fixing the patient's eye.

In the case of a blind man, no arrangement of this kind can be made, and it frequently involves a trial of patience and ingenuity, to get such a person to hold his eye steadily, even for a few seconds, in the direction required. It is necessary, however, under these circumstances, that the patient should keep his head erect, and directly opposite the observer's; unless this be insisted on, it is difficult for a person not constantly in the habit of working with the ophthalmoscope, to make a satisfactory examination of the eye.

Management of the instrument.

In using the ophthalmoscope, the sight-hole of the instrument should be applied to whichever of the observer's eyes is most convenient to himself, its rim being made to rest against his eyebrow, and as he turns his head, the instrument will move with it. The object lens in front of the patient's eye, should be held a little obliquely between the thumb and forefinger of the other hand, the ring and middle fingers resting against the patient's forehead, which thus acts as a fixed point, enabling the observer to approximate or withdraw the object lens to or from the patient's eye, so as to bring the retina into focus with the greatest precision, and also to follow the movements of the eye under examination.

The beginner may be troubled by the reflection of the ophthalmoscope from the cornea of the patient. It appears as a brilliant image of the mirror on the surface of the cornea, hiding that part of the retina which is behind it. It is easy to get rid of this reflection by slightly rotating the object lens to one side or the other, when it will disappear, and the retina be clearly seen.

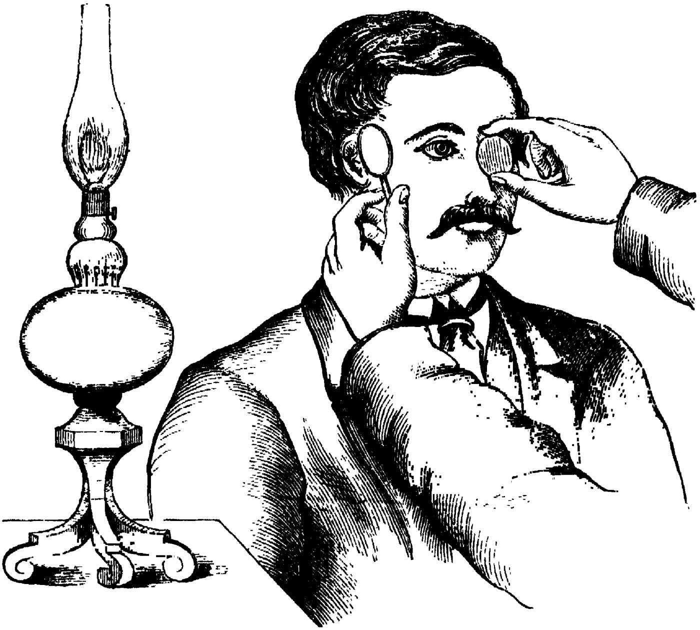
The erect image.

Examination of the virtual erect image.—As I have already explained, p. 25, in this mode of examination the observer has to go inconveniently close to the patient's eye, and the lamp must therefore be placed on the side corresponding to the eye under examination. The beginner will find more difficulty in gaining a distinct view of the fundus of the eye by this means, than by the examination of the actual inverted image; nevertheless, it produces a much larger image, so that the fundus of the eye may thus be studied in detail with great accuracy, and in all doubtful cases both methods of examination should be employed. By greatly diminishing the size of the mirror perforation, we may even see the details of the fundus oculi, in the undilated pupil, by the direct method.

Lateral illumination.

The lateral method of illumination, or the examination of the eye by transmitted light.—For this purpose the observer and patient are seated opposite one another, and the lamp is placed in advance, and to one side of the latter, in order that its rays may be concentrated upon the eye under examination by a convex lens, as shown in Fig. 7. The eye being illuminated in this way, the observer can magnify any part of the lens, iris, or cornea with a convex glass held in front of the eye.

FIG. 7.



In examination of cornea, iris, and lens.

By this means valuable aid is afforded the surgeon, especially in detecting foreign bodies in the interior chamber, or in cases of synechia and occlusion of the pupil from false membranes. Nebulæ also, which it is difficult to appreciate with the unaided eye, may thus be distinctly defined. In fact, abnormal changes going on in the lens and the structures anterior to it, are most advantageously studied by the lateral method of illumination.

OPHTHALMOSCOPIC APPEARANCES OF THE HEALTHY EYE.

Colour of the healthy fundus,

Colour of the Fundus.—I must observe, in the first place, that the whole of the interior of the retinal sphere which can be brought into view through the pupil, or the fundus oculi, as it is usually termed, is among the natives of India, and indeed of all dark races, very different in colour from that which is present among Europeans. Fig. 1, Pl. IV., being a drawing of the latter, and Fig. 2, Pl. IV., of the former. This difference arises from the light being reflected back from the deep brown or black pigment, filling the hexagonal cells of the choroid in the native, and obscuring the vascular structure which is situated behind it, as observed with the ophthalmoscope, so that the fundus of the eye appears of a *brownish-grey* colour among these people; whereas in the European it is of a *crimson orange* hue, the incident light being reflected principally from the vascular network of the choroid, which is seen through the transparent retina.

varies in different races,

The precise tint of the fundus oculi must of course vary in each individual, depending upon the depth of colour of the pigment contained in the hexagonal and choroidal cells; for instance, the inhabitant of Bengal being comparatively fair, the fundus of the eye, when examined with the ophthalmoscope, appears of a grey colour, whereas in the very dark-skinned native of the South of India it will be almost black.* And so also with the European; in the light-haired people of the northern countries, the fundus is of a bright scarlet colour, and in consequence of the almost entire absence of pigment in the part, the larger vessels of the choroid will be clearly seen; but in the black-eyed people of Spain and Italy, the colour of the fundus will be proportionably darker, approaching, in fact, to that of the natives of India.

and individuals.

Pathological varieties.

It is by no means an uncommon circumstance to find the fundus of a native's eye of a deep red colour, resembling that of the European; but this depends upon congestion of the vessels of the retina and destruction of the hexagonal cells, so that a certain amount of light is reflected from the choroid, and, combined with that from the congested retina, causes the fundus to appear red. Under these circumstances, other alterations will be at once perceptible, enabling us to determine the nature of the disease, but these I will not now stop to describe. It is sufficient to repeat, that in the healthy eye of the native of India, the fundus oculi is of an uniform greyish-brown hue, the exact shade depending upon the colour of the pigment cells of the elastic lamina and choroid, the only exception to this being in those parts of the retina occupied by the retinal vessels and the optic disc; on the other hand, in fair people, the reflection from the fundus oculi, as seen with the ophthalmoscope, is of a bright scarlet colour, in consequence of the light falling on the vascular choroid, the hexagonal cells containing little or no pigment.

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* Dr. G. Smith, Prof. of Ophthalmic Medicine, Madras Medical College: *Madras Quarterly Journal of Medical Science*, No. 15, Feb. 1864.

Peculiarities of dark races.

The fundus in the dark races.

After what I have stated, it is almost superfluous to add that in the healthy eye of the native it is quite impossible for us to see the sclerotic with the ophthalmoscope; for if the hexagonal cells hide the choroid, much more must they, together with the pigment cells of the choroid, entirely conceal the sclerotic. This remark does not, however, hold good with regard to the optic disc; over this spot there are no pigment cells, the only structures that cover the lamina cribrosa being the nerve fibres of the optic disc and its capillary vessels, and hence the colour of the disc, the light being mainly reflected from the fibres of the lamina cribrosa; and in the centre of the nerve, where the separation of the fibres towards the margin leaves the lamina most exposed, we may sometimes see a sort of mottling, due to the difference in colour between the fibrous tissue of the lamina itself, and the nerve tubules which occupy its openings.

Appearance of the optic disc.

The *optic disc*, or *papilla*, which is the termination of the optic nerve, or the spot at which it expands into the retina, will be found about one-tenth of an inch internal to the axis of the eye; it is the first point which would naturally attract the observer's attention in making an examination with the ophthalmoscope. The shape of the healthy papilla is circular, but it varies somewhat in different individuals: sometimes it is elongated from above downwards, but never from side to side, unless as the result of disease. Its size, too, is by no means the same in all cases, and will, of course, appear to be augmented or lessened according to the power used to magnify it. The colour also of the papilla is subject to variation: it is of a more decided pink hue in the native of India's eye than in the European—in fact, among the latter races, it is of a transparent, greyish-tint, with a slight admixture of blue; but it may be of a lighter or darker pink, without there being any reason to suppose the part is diseased. The colour of the optic disc is due to the reflection of light from the lamina cribrosa, bloodvessels, and nerve tubules composing the optic papilla.*

Its form and colour

In many cases the ophthalmoscope exhibits round the optic disc a dark ring or crescent, which depends upon a collection of pigment in the choroid, in the immediate neighbourhood of the nerve, and has no pathological signification. At the point where the lamina cribrosa ceases, the optic nerve is contracted, and the opening in the choroid being narrow, in a certain measure compresses the nerve trunk; for this reason, a sort of double border is often seen around the margin of the optic papilla.

Varieties.

With regard however to the limits of the nerve, or the circumference of the disc, the following description is quoted from Liebreich :—"Under the choroidal margin is the line, more or less dark, that indicates the border of the opening in the choroid; under the sclerotic margin is a bright crescent or circle, formed by the curving round of the sclerotic fibres, and appearing between the choroidal margin and the fine greyish line that indicates the narrowest part of the nerve itself, and is therefore called the proper nerve-boundary." The latter under normal circumstances is not usually very sharply defined, but in abnormal changes of the papilla appears more distinct. The choroidal border is always strongly marked, especially at the outer border

Nerve boundaries.

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* Professor Longmore's "Manual of Defective Vision in Soldiers," p. 48.

of the disc, presenting often a well-defined deposit of pigment, which must not be mistaken, as I have before remarked, for a diseased condition of the parts.

The retinal vessels;

The point at which the *central artery and vein* of the retina enter the eye through the optic disc is subject to considerable variation. Generally the artery passes through the whitish and depressed centre of the papilla, and, after emerging from the disc, divides dichotomously, its branches ramifying in all directions towards the periphery of the retina; but the central artery may perforate the disc at any other point; not unfrequently one or two larger branches are noticed in the centre of the papilla, while others pass through its circumference, perhaps close up to the scleral margin of the disc.

estimation of their calibre.

The apparent calibre of the vessels will vary with the magnifying power employed in observing them; practice alone will thus enable us to appreciate abnormal changes in the calibre of these vessels. One frequently reads accounts in which the retinal vessels are said to be over-full or empty, as the case may be; but in truth it is most difficult to determine this point.

Arteries double-contoured.

The retinal veins are smaller than the arteries, and in consequence of their thinner coats their contents are readily seen; they appear, therefore, when examined with the ophthalmoscope, of a darker and more uniform colour than the arteries, and the latter seem to be transparent in their centres; this arises from the difference in the degree of illumination of the prominent centres of the arteries, as contrasted with their sides: from their conformation, it is evident that the sides of a vessel would receive and reflect relatively less light, and therefore appear in shade.

Venous pulsations.

If in the normal eye the central vein be carefully examined, a pulsation may be noticed in it, which will be rendered more evident on gentle pressure being made on the eyeball. If the compressing force be increased beyond a certain point, the pulsation at once stops, and the veins become almost invisible from the cessation of the flow of blood through them. In the healthy eye no arterial pulse can be seen, but if pressure be made on the eyeball it will become apparent. We notice this in a very marked manner in cases accompanied with considerable intra-ocular pressure, as for instance, in glaucoma.

Mottling of the disc.

The colour of the optic disc is not uniform, its outer part being greyish and mottled. This appearance is caused by the difference in the light reflected from the nerve tubules, which is greyish, and that from the white glistening bands forming the lamina cribrosa. At the point of exit of the retinal vessels the white appearance is very marked, and often presents a little pit or hollow. The inner half of the disc is of a decidedly redder tint than the outer half, because it is more thickly covered by vessels and nerve fibres, and hence there is no reflection from the fibres of the lamina cribrosa in this situation. It is absolutely necessary to become acquainted with the different appearances which may be presented by the healthy optic disc, or these varying conditions may be mistaken for indications of disease; the outer greyish-white tint, the central depressed appearance and whitish hue, together with the inner pinkish half of the disc, are conditions which vary considerably, but are more or less distinctly recognisable in all healthy eyes.

Appearance of the retina, almost transparent.

The Retina.—As I have already remarked, the retina is so transparent a structure, that when examined by the ophthalmoscope the small amount of light reflected from it is lost in the abundant reflection from the bright red background of the choroid; but in the case of the natives of India and other dark races, the retina may be distinctly recognised as a grey, striated layer, lying over the black hexagonal cells of the choroid, and extending from the circumference of the optic disc as far outwards as the ora serrata.

The macula lutea.

The macula lutea will not be recognised unless after some practice with the ophthalmoscope. It is situated in the axis of vision, and its position may be at once found from the fact of the retinal vessels passing above and below it, but not crossing the macula lutea. The region of this spot is of a bright red colour, and the foramen centrale appears as a little light ring in it.

The appearance of the choroid.

The Choroid.—In discussing the anatomy of the choroid, p. 6, I remarked that layers of very small capillary vessels are placed immediately behind the elastic lamina of the choroid, and between these layers and the sclerotic, the venæ vorticosæ and large branching pigmented cells of the choroid are situated; it follows, in consequence of this arrangement of the vessels, that when examining the eye with the ophthalmoscope, that light passing through the transparent media, falls on the capillary layer behind the retina (provided the hexagonal cells of the choroid are transparent), and the light which is reflected back to the eye of the observer from this layer of fine capillary vessels, gives the uniform red colour of the background of the eye in the healthy fair-skinned European. In albinos, or in persons in which there is very little pigment in the choroid, the larger vessels of the venæ vorticosa may be seen. Evidently, as the vascular pigmented layers of the choroid line the inner surface of the sclerotic, it is impossible to see this latter structure with the ophthalmoscope, unless, as often happens in consequence of partial atrophy of the choroid, a portion of its vascular and cellular structures is destroyed, and then the white glistening sclerotic may be seen through the choroid.

The sclerotic.

The cornea, aqueous lens and vitreous, being in the healthy eye perfectly transparent, no light is reflected from them when under examination by the ophthalmoscope, and consequently they are not seen.

Systematic examination of the eye.

A Systematic Examination of the Eye should, as Professor Longmore remarks, be adopted in all cases of impaired vision; a patient of the kind consulting us, we should—

1st. Endeavour to obtain a clear history of the case by means of a few leading questions, and while doing this, can make an examination of the external structures of the eye, including the muscular apparatus, and also ascertain the tension of the globe of the eye.

2nd. If the nature of the disease is not determined by the above examination, we should place the patient at twenty feet distance from Snellen's test types, No. CC to No. XX, and ascertain his acuteness of vision: if this is at fault, we should hold first convex, and then concave glasses before his eyes, and note how the sight is altered thereby. First one eye and then the other must be examined in this way. If there is a suspicion that astigmatism exists, a conclusion may be arrived at on the subject by aid of Snellen's horizontal and vertical test lines. Failing to discover anything wrong in the refraction or accommodation of the eyes, we should proceed to examine:—

3rd. As to the extent of the field of vision; and

4th. Make an ophthalmoscopic examination of the eye by the direct method, which will enable us to detect slight changes in the cornea, lens, or vitreous, also to diagnose further than we have already done by means of the examination above mentioned, the existence of myopia or hypermetropia, especially in the case of children; the lens and anterior media may subsequently be examined by the lateral method of illumination.

5th. And lastly, every part of the fundus of the eye should be carefully examined with the ophthalmoscope, by the indirect method.

CHAPTER III.

DISEASES OF THE ORBIT.

Injuries of the orbit—Diseases of the bones—Inflammation of the cellular tissue—Orbital growths and tumours—Dislocation of the globe of the eye—Extirpation of the eyeball—Diseases of the lachrymal gland.

INJURIES OF THE ORBIT.

FRACTURES AND CONTUSIONS.

CONTUSIONS AND FRACTURES.—A blow or fall on the outer ridge of the orbit is, as a general rule, followed by no worse results than a "black eye," but in some instances it has been succeeded by effusion of blood within the cranium, inflammation, and death.* Some few cases have been recorded in which the bones forming the outer edge of the orbit have been fractured by direct violence. If the fracture extend into the frontal or maxillary sinus, emphysema of the eyelids will most probably follow.

Fracture extending from other parts.

Fracture of the walls of the orbit not unfrequently occurs as an extension of a fracture from some other part of the skull. For instance, the frontal bone may have been fractured and symptoms of compression exist; the depressed bone may have been removed with the trephine but the symptoms remain unrelieved. In several instances of this kind it has been discovered after death, that the fracture of the skull has extended to the orbital plate of the frontal bone, and laceration and protrusion of the brain have occurred in this locality.

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* Mackenzie on "Diseases of the Eye," 3rd edit., p. 2.

Fracture from contre-coup.

The walls of the orbit are occasionally fractured, the primary injury having been received upon the vertex or other part of the skull. Should the orbital plate of the frontal bone be fractured in this way, marks of injury on some portions of the skull will be observed, and as a general rule in cases of this kind there is considerable ecchymosis of the lower eyelid; but traumatic extravasation of blood in this locality may also occur under the following circumstances:—1. From an effusion of blood beneath the integuments of the skull, if it does not gravitate backwards, often produces an ecchymosis in the cutaneous surface of the eyelids, but never of the conjunctiva of the lids or globe. 2. That a blow directly upon the eyeball may give rise to an ecchymosis of the conjunctiva, both of the globe and lids. 3. That when fracture of the base of the skull is indicated by ecchymosis, this ecchymosis appears first beneath the conjunctiva of the globe, then beneath the palpebral conjunctiva, and only subsequently in the integument of the eyelids, if at all. 4. That when the injury has been such as to make a fracture probable, external ecchymosis of the lower lid, and less frequently of the upper lid, is a significant symptom only, when it accompanies ecchymosis of the globe, or follows it after an interval.*

Situation of the ecchymosis.

PENETRATING WOUNDS.

PENETRATING WOUNDS OF THE ORBIT are of a trivial or dangerous character, according to the nature of the instrument inflicting the injury, and the depth and direction which it has taken; if this has been deep and directly backwards, or upwards and inwards, it is not at all improbable that the brain may have been reached, and the results may be most serious.

Search for a foreign body;

The first point to be ascertained in the case of a punctured or gunshot wound of the orbit is, as to the presence of a foreign body in the wound: our finger or probe will be our best guide in arriving at a conclusion on this point, and should we discover such a foreign body lodged in the orbit, we must, if necessary, enlarge the external opening to such an extent as to enable us to remove it. Instances are recorded in which a bullet has remained embedded in the orbit

and remove it.

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* Clinical Lecture, by Dr. R. M. Hodges, *Boston Medical and Surgical Journal*, April, 1873.

for years, apparently without inducing any ill effects; but these cases are by no means to be taken as precedents for allowing a foreign body to be left in this situation; for in ninety-nine cases out of a hundred, unless the foreign body be removed, inflammation, and suppuration of the tissues of the orbit will ensue, and very possibly irreparable damage be done to the eye.

Direction of injury affects prognosis.

The second point to be noticed is the direction which the instrument has taken, for as I have before stated, if this be towards the brain, the case may be a most serious one, and our prognosis must be correspondingly guarded. The extent of the external injury cannot be relied on as an indication of the severity of the wound; in fact, on a casual examination no contusion may be detected in the skin, the eyelids having been open, when the instrument inflicting the wound passed through the orbit and entered the brain. This point is forcibly illustrated by the following case, related by Mr. Guthrie:* A boy was struck while at play with an iron wire in the right eye; there was no external wound to be seen, but there was considerable chemosis of the conjunctiva of the upper and inner part of the eyeball. Four days after the accident the patient complained of sickness and pain in the head; this was followed by restless delirium and coma, and on the sixth day after the accident the patient died. On examination, it was found that a piece of the iron wire had passed under the upper lid, and through the posterior part of the orbitar plate of the frontal bone into the anterior lobe of the brain, which was softened and bedewed with matter. This case shows the extreme caution necessary in forming a prognosis under such circumstances.

External wound no guide.

Case.

Fatal head symptoms.

If for twelve or fourteen days after the accident has occurred, no head symptoms have supervened, we may be hopeful as to the result, but the patient is not positively safe from ulterior bad consequences for some time afterwards.

GUNSHOT WOUNDS.

GUNSHOT WOUNDS OF THE ORBIT, in a practical point of view, differ in no respect from punctured wounds, always taking into consideration the occasional unaccountable wanderings which a ball pursues in this, as in other parts of the body. As already directed in the case of other foreign bodies, the presence or not of the bullet in the orbit must first be determined, and then the direction it has taken ascertained; lastly, it is as necessary to remove a ball from this situation as any other substance. We occasionally meet with instances in which a number of small shot have penetrated the conjunctiva, and perhaps, glancing off from the sclerotic, have become imbedded in the cellular tissue of the orbit. In a case of this kind, all the shot that can be extracted without making a deep incision into the cellular tissue, should be removed; the remainder will become encysted, or in time make their way to the surface, and may then be extracted; it is not advisable to search for them in the deeper structures contained within the orbit.*

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* "Commentaries on Surgery," p. 374, 6th edit., 1865.

Small shot in orbit.

May be encysted.

DISEASE OF THE BONES.

PERIOSTITIS OF ORBIT.

INFLAMMATION OF THE PERIOSTEUM of the bones of the orbit may be either acute, or chronic, and the symptoms to which it gives rise will accordingly vary in their intensity, and in the rate at which they advance.

Periostitis in this situation most commonly arises from direct injuries. It may apparently be induced in some cases by exposure to cold, or from disease of neighbouring parts; in many instances, however, syphilis, either acquired or hereditary, is the primary cause of the disease. If the periosteum of the external margin of the orbit be affected, a swollen, and on pressure, exquisitely painful spot will be detected; but if the membrane towards the back of the orbital fossa is involved, it is a more difficult matter to ascertain the nature of the disease. The patient usually complains of violent, deep-seated pain in the orbit, which increases towards bedtime; as the disease advances, the inflammatory action is likely to extend to the cellular tissue of the orbit, terminating in suppuration; the conjunctiva of the eyeball becomes deeply congested and swollen, and the globe protrudes more or less from its socket. In the earlier stages of

Causes.

Symptoms.

Pain increased on pressure.

Eye protrudes.

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* Poland on Protrusion of the Eyeball: *Ophthalmic Hospital Reports*, vol. ii. p. 218. Also a case by Dr. Playne, vol. i. p. 215.

periostitis so situated, if pressure be made with the point of the finger deeply into the orbit, we may probably detect a particularly painful spot corresponding to the diseased periosteum, and if nocturnal exacerbations of pain are well marked (the patient having had syphilis) we may be tolerably certain as to the nature of the malady. In neuralgia, for which, it is said, by so high an authority as M. Trousseau, that this affection might be mistaken, there is tenderness on pressure over the spinous processes of the first two cervical vertebræ, and such pressure very constantly awakens pain in the branches of the nerves given off from this portion of the spinal cord; this would not be the case in periostitis of the orbit.*

Distinguished from neuralgia,

and from cellular inflammation.

It is often, however, difficult, to form a diagnosis between acute periostitis of the deeper parts of the orbit, and inflammation of its cellular tissue,† nevertheless, it is important if possible to arrive at an accurate opinion on the subject, because, in the former class of cases, unless we assist the matter to escape speedily from the orbit, necrosis of the neighbouring bone is very likely to result; there is less fear of this in inflammation of the cellular tissue. In cases of periostitis, as above remarked, by pressure against the walls of the orbit, we may sometimes reach one particular spot that is exquisitely painful; or by forcing the eyeball back into the socket, this tender spot may be indicated. Moreover, as the swelling of the periosteum and cellular tissue around it will at first be limited, the eyeball will be protruded in the opposite direction, to that in which the inflammation is situated; for instance, if the periosteum in the upper part of the orbit is inflamed, the globe of the eye will be thrust downwards. In diffuse inflammation of the cellular tissue of the orbit, no one spot will be more painful than another, and the protrusion of the eyeball will be uniform; the skin of the lids becomes more deeply involved, and the course of the disease is more rapid than in acute periostitis; nevertheless the diagnosis is often very perplexing, and we may find

In periostitis, pain localized;

Exophthalmos one-sided.

The reverse in cellulitis.

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* M. Trousseau on Neuralgia: *Medico-Chirurgical Review*, vol. xxxiv. p. 255, 1864.

† A Gräfe on Exophthalmos: *Ophthalmic Review*, vol. i. p. 137.

ourselves at fault after carefully weighing all the points in the case.

Treatment.—If, from the intensity of the symptoms, we have reason to suppose that suppuration beneath the periosteum has taken place, we are justified in exploring the part with a grooved needle; and should we discover the presence of pus, we must at once cut down along the needle upon the collection of matter, and allow it free exit. If this is not done, destruction of the bone will surely occur, or, it may be, the inflammatory action will extend to the lining membrane of the skull.* I need hardly remark that great caution should be exercised in making an incision into the orbit, on account of the complicated anatomy of the parts, but we are bound, nevertheless, to operate without hesitation. I have in several cases of the kind, after exploring the part with a grooved needle, run a strong iron probe along the groove of the instrument, and so torn open the cellular tissue, simply incising the skin, so as to give exit to the pus.

Treatment.

Explore the part.

Give exit to matter.

In the subacute and more chronic forms of periostitis, iodide of potassium and cod-liver oil may control, if not cure the disease, and these remedies should, at any rate, be allowed a fair trial.

Iodide of potassium.

NECROSIS.—Necrosis of one or more of the bones forming the orbit, as has just been remarked, may occur as a sequence of periostitis, or it may take place in consequence of direct violence, or from inflammation of the cellular tissue of the orbit. I have had a case of this kind lately under my care. A man of the name of Tait, a guard on the E. I. Railway, was exposed to severe cold on the 5th of December, 1866; the following day violent inflammation of the cellular tissue of the right orbit set in, and at the end of fourteen days a considerable quantity of pus escaped through an opening at the inner and upper part of the superior eyelid. Ultimately a fistula formed in this situation, and small portions of necrosed bone have since been constantly coming away. I saw this man in June for the first time; dead bone was then to be felt in the roof of the orbit, and he was perfectly blind with the right eye.

NECROSIS OF ORBIT.

Case.

Following inflammation of cellular tissue.

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* Poland on Protrusion of the Eyeball. Case of severe cerebral symptoms, coma and death, following an internal node of the orbit: *Ophthalmic Hospital Reports*, vol. ii. p. 225.

Notwithstanding this blindness, which had been complete since the third day from the first appearance of the disease, the muscular apparatus of the eyeball was normal, and in fact the eye, on a superficial examination seemed healthy; but on making an ophthalmoscopic examination, I found the optic disc atrophied, being circular and of a dead white colour, and the vessels of the retina were contracted. The inflammatory action had attacked the cellular tissue of the orbit, and extending to the optic nerve, had induced atrophy of the papilla.

Ending in atrophy of the papilla.

Treatment.

Treatment.—In instances of necrosis, unless exfoliation has taken place, it is better to wait patiently, allowing nature to take her course, till the dead bone has separated, when it may be cut down upon and removed. The structures contained in the orbit are closely packed and of an important character; except, therefore, in instances unequivocally demanding the use of the knife, it is advisable to be as sparing as possible of its employment.

Sparing interference.

CARIES.

CARIES OF THE BONES OF THE ORBIT.—The following case affords an instance of the terrible mischief which sometimes results from this disease, especially under injudicious treatment:—

Case.

Grish Chunder Sing, aged eighteen, admitted into the Calcutta Ophthalmic Hospital on August 20th, 1865. Up to within the last twelve months he has enjoyed good health, and been employed as a compositor; there is no history of either hereditary or acquired syphilis in this case. A year ago he began to suffer from pain in the head, and shortly afterwards from a discharge of blood and matter from the nose; for this he was salivated by his friends, the ptyalism lasting two months; he also had leeches applied to his temples. Some time afterwards, on rising one morning, he discovered that he could no longer see with the left eye, and within the last month the sight of his right eye has gone also, so that he is now completely blind. His digestive system is in good order, and his mental faculties are perfect, he has, however, lost the sense of smell. The right eyeball protrudes considerably, and the cornea is hazy. There is a fistulous opening at the inner part of the left upper eyelid, and through this a probe may be passed far back into the orbit; no dead bone can be felt. The left eye is less prominent than the right one,

Prolonged salivation.

Loss of sight and smell.

Fistulous opening.

and the dioptric media are transparent: the margin of the optic disc is ill-defined, and like the retina looks cloudy; the retinal vessels are of normal size. The patient gradually became weaker, he was troubled with severe pain in the head and often had attacks of obstinate vomiting, but his speech and mental faculties remained perfect. Soon after his admission both eyeballs were observed to throb or pulsate in a most remarkable manner after the slightest exertion, for instance on rising in bed, the pulsations being synchronous with those of the heart.

Cerebral symptoms.

Pulsation of eyeballs.

The boy died on the 18th February, and on making a post-mortem examination, I found that the whole of the orbital plate of the frontal bone, and the greater part of the body of the sphenoid, had been destroyed by caries, so that nothing but the thickened dura mater intervened between the brain and the tissues contained in the orbital fossa; the pulsation of the globes was thus easily accounted for. The optic nerves were softened and destroyed, but the vessels and nerves entering the orbit were so intimately associated with the diseased structures, that it was impossible to dissect them out, or determine their individual condition. The inferior portions of the anterior lobes of the brain were softened, but presented no other morbid appearances.

Extensive caries.

Nerves and brain implicated.

Fɪsᴛᴜʟæ.—Caries of the walls of the orbit is, fortunately, by no means always so destructive as in the case of this lad; the disease is often confined to a small portion of the bones, and a fistulous opening forms between this spot and the skin, through which a thin watery fluid constantly oozes away, and the soft disintegrated bone may be felt with a probe.

Fɪsᴛᴜʟæ, following caries.

The fistulæ thus formed in cases of necrosis and caries are frequently more troublesome to cure than the disease itself; the external opening is maintained by adhesions to the periosteum, and thus a puckered cicatrix forms, which often leads to eversion of the eyelid.

Fistulous openings of this kind are probably best treated by injecting the *liqueur villate* of the French surgeons, or a similar preparation, into the fistula every third or fourth day.* At first, the injection may

Treated by injections.

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* The following is the composition of the *Liqueur Villate*, after M. Notta:—Liquid subacetate of lead 30 parts, sulphate of copper

cause considerable pain and inflammation, but this soon subsides, and each subsequent injection causes less irritation. In some of these cases not only does the fistula heal under this treatment, but healthy action appears to be excited in the diseased bone.

INFLAMMATION OF THE ORBITAL TISSUES.

ACUTE CELLULITIS

INFLAMMATION OF THE CELLULAR TISSUE.—The cellular tissue contained within the orbit is occasionally the seat of acute inflammation and suppuration, but except as a complication of traumatic cases or periostitis this affection is very rare; those instances that do occur usually arise from the spread of erysipelas to the part, when the patient is in a low and weak condition of health. Under these circumstances the eyeball itself generally escapes, but, unfortunately, the patient's sight is too often much impaired, if not destroyed, from the extension of the inflammatory action to the optic nerve, as in the case of Tait (p. 47), or from effusion into the retina and its detachment from the choroid. Occasionally the matter burrows into the sheath of the muscles, deranging their action and giving rise to diplopia. A much more serious complication is apt to occur in the course of this disease, in the form of pyæmia; thromboses have been observed in fatal cases of this kind, extending into the sinuses of the brain, and even into the jugular and innominate veins.*

from the spread of erysipelas,

may cause blindness,

or pyæmia.

The Symptoms of inflammation of the cellular tissue of the orbit are as follows:—The patient complains of a throbbing pain in the part, extending to the temple, side of the head, and frequently to the muscles of the back of the neck; the pain is sometimes excruciating, and the patient is usually feverish and restless; if he falls off to sleep he probably suffers from fearful dreams. The eyelids are swollen and of a dusky red colour, the conjunctiva becomes uniformly congested and chemosed, and the eyeball is rapidly protruded to

Pain.

Fever.

Swelling and discoloration.

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and sulphate of zinc each 15 parts, white vinegar 200 parts—*Medico-Chirurgical Review*, April, 1866, p. 556.

M. Nélaton also speaks in favour of this practice.

* French translation of Mackenzie's "Treatise on the Eye," vol. iii. p. 136.

an uncertain extent, in consequence of the effusion that takes place into the cellular tissues of the orbit. This protrusion is peculiar, in that the globe is usually thrust directly forwards, and not, as in periostitis and in the case of various tumours, with a certain deviation from the axial line, according to the direction of the compressing force. The cornea may remain bright and clear, or it may be that from exposure to the atmosphere, the secretions on its surface, and that of the conjunctiva, form hard dark crusts; the cornea becoming cloudy from desiccation of its epithelium, necrosis follows, and the eye is destroyed.

Exophthalmos.

In the course of ten or twelve days from the commencement of the attack, we may generally detect one or more points at which fluctuation can be felt, usually at the lower and inner part of the eyeball. As soon as the pus has been evacuated, the pain and swelling diminish, the eyeball sinks into its socket, and the parts regain their normal position. But although the eyeball may not be directly destroyed by the inflammatory process, yet, as I have before remarked, in very many of these cases the optic nerve is more or less involved, and is subsequently very apt to become atrophied; or necrosis of the bones of the orbit, or the formation of extensive cicatrices, may ultimately lead to atrophy of the globe.

Suppuration.

Atrophy of the optic nerve,

or globe.

In CHRONIC INFLAMMATION of the cellular tissue of the orbit the symptoms are less severe than those above described. The patients are generally the offspring of syphilitic or scrofulous parents, or of old and worn-out ones.

CHRONIC INFLAMMATION.

The inflammatory process usually begins in the periosteum, the patient complaining of pain in the part, which increases towards evening, probably extending over the forehead. As the inflammation advances, the cellular tissue of the orbit becomes involved, the conjunctiva and lids are red and swollen, and the eyeball is thrust forward to a greater or less extent; the pain, however, is far less severe than in acute inflammation of the cellular tissue, on account of the gradually increasing pressure to which the parts are exposed. The protrusion of the eyeball in these cases is often considerable, and as their progress is slow, it is only by a careful study of the collateral symptoms that we shall avoid an erroneous diagnosis. In cases in which a

Symptoms as in the acute form,

but less severe.

Distinguished from orbital tumours and abscesses. morbid growth causes the eyeball to protrude, its axis usually deviates from its natural position, according to the direction of the pressure occasioned by the tumour (*see* Figs. 8 and 9); whereas in inflammation of the cellular tissue this is not the case. In doubtful instances, we may further satisfy ourselves as to the presence or not of pus in the orbit, by the aid of a grooved needle, taking care not to run the point of the instrument in the direction of the brain.

Case. Sir W. Lawrence* mentions the case of a child, ten years of age, brought to him suffering with an affection of the right eye, which was said to have existed for a week. The globe projected half an inch further forward and outward than the left one. The internal angle of the eye and parts around it were red and swollen, and deep-seated fluctuation was obscurely perceptible in the orbit. A lancet was thrust three-quarters of an inch deep into the part, and out flowed a dessertspoonful of pus. The progress here was rapid, and the wound healed in a week; but these **Duration uncertain.** chronic abscesses may even take years to develope themselves, as in an instance recorded by Dr. Mackenzie.†

The Treatment of inflammation in the cellular tissue of the orbit, differs in no respect from that of similar affections in other parts of the body. In the early stages of the more sthenic forms of inflammation in **Leeches. Cold compresses.** this situation, we may endeavour, by leeches and cold compresses constantly applied, to allay the irritation going on in the part, and to prevent suppuration; but if this does not succeed, we must then promote it by **Poultices.** means of poultices and hot fomentations. As soon as matter has formed, the abscess should be freely incised and the pus evacuated, the poultices being continued till the suppuration ceases.

Stimulants in erysipelas. If the case is complicated with erysipelas, I need hardly say that antiphlogistics are not to be thought of; on the contrary, the patient's strength must be supported, the pulse and the temperature of the body being our safest guides as to the amount of nourishment and **Tr. ferri.** stimulants required. I have great faith in the sesquichloride of iron in these cases: fifteen drops of the tincture should be given every six hours, with as many grains of chlorate of potash; it appears to act by determining a rapid oxidation of the blood, and in this way the poisonous materials, whatever they may be, which induced the attack, are destroyed. Opium, or still better, the chloral hydrate, will be required to enable the patient to sleep; indeed, in the early stages of this form of the disease, there is no better practice than to give the system rest, and at the same time support the patient's strength with soup and stimulants, administering also the tinct. ferri sesquichlor.; we may thus hope to ward off the suppurative stage of the affection, or at any rate promote its speedy termination. We must bear in mind the fact, that so long as the inflammatory action lasts, the close proximity of the parts to the brain endangers its extension to the cerebral membranes, a complication likely to lead to the most serious consequences.

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* Lawrence on "Diseases of the Eye," 2nd edit. p. 744.

† Mackenzie, "Diseases of the Eye," 4th edit. p. 302.

Opium. Chloral.

Support the patient.

Brain in danger.

INFLAMMATION OF THE CAPSULE OF TENON occasionally occurs in rheumatic subjects; in other cases it is said to arise from injuries to the part, or it may be from extension of erysipelas from neighbouring structures.*

INFLAMMATION OF CAPSULE OF TENON.

Symptoms.—The subconjunctival tissue is deeply injected, but the iris is healthy, nor can we easily account for the persistent chemosis and injection of the vessels in question. The patient complains of slight pain in the eye, particularly when he turns the eyeball from side to side, but there is no impairment of vision; slight protrusion of the eye may occur, and the mobility of the globe be impaired, so that diplopia may exist.

Subconjunctival injection.

Pain.

Exophthalmos.

The symptoms above described usually disappear after a time, and no serious consequences are likely to follow, unless in cases preceded by erysipelas, when the optic nerve is liable to become involved, optic neuritis and atrophy of the papilla resulting.

Treatment.—Hot compresses generally give the patient much relief, and iodide of potassium in large and repeated doses often appears to be very serviceable, but as a general rule in these cases Nature will effect a cure, and we may often with advantage wait patiently for this result.

Warmth.

Pot. iodid.

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* "Maladies des Yeux," Wecker, vol. i. p. 696.

interval, exophthalmic goitre gradually disappears of itself, the patient's general health improves, the palpitations and other nervous symptoms from which he suffered abate, and the enlargement of the thyroid gland, and protrusion of the eyeballs, subside. Suppuration of the cornea and destruction of the eye may, however, occur, from the exposure of the uncovered cornea to the air, or it may be due to paralysis of the "trophic" fibres of the fifth nerve.

Treatment.

Treatment.—From the foregoing history of this malady, we learn that it is no mere local affection, and the remedial measures we adopt must therefore be mainly directed to restore the general health; and as the large majority of cases occur in women, and are attended with catamenial derangement from their commencement, and often with anæmia, our treatment should be further directed by attention to these special features.

Promote the general health.

Hydropathy.

Trousseau recommends a judicious use of hydropathy, among other measures, as likely to improve the patient's general health; and he regards this as being the best and only rational plan of treatment in such cases. Galvanization of the cervical sympathetic with a weak ascending current, not only lessens the size of the thyroid gland, but seems to exercise a favourable influence on the course of the disease.* A firm compress and bandage may be employed with advantage, especially if the cornea becomes at all hazy. Should the retraction of the upper lid be very marked, the following operation may be advantageously performed. The horn spatula having been introduced beneath the lid to be operated on, a horizontal incision is to be made through the skin of the lid above, and parallel to the upper border of the tarsal cartilage. A portion of the fibres of the orbicularis muscle, and subjacent fascia, is to be divided so as to expose the levator palpebræ; and those fibres of this muscle which pass over and into the tarsal cartilage are to be very carefully cut through. An incomplete ptosis results, but this gradually diminishes, and neutralizes the retraction of the lid, if the operation is successful.†

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* *The Practitioner*, 1873, p. 186.

† *Compte-Rendu of the Congrès d'Ophthalmologie*, 1867.

Cystic Tumours of Orbit.

Cystic Tumours growing within the orbit are another cause of exophthalmos. In this situation, such tumours are usually attached to some portion of its bony wall. Their contents vary, being sometimes watery (hygroma), like suet (steatoma), like pap (atheroma), or like honey (meliceris). As in the case of ovarian tumours, they often contain a number of hairs.

Contents various.

It is almost impossible, before operating, to ascertain the connexions which many of these cysts form with surrounding parts; they sometimes extend backwards into the orbit, and even through the optic foramen, and as they are liable to suppurate at any time, they may excite dangerous inflammation of the tissues contained within the cranium.

Absence of pain. Slow growth.

Symptoms.—Cystic tumours in this situation usually increase in size very slowly, and without causing the patient any pain or much inconvenience, until they attain a considerable bulk and begin to displace the eyeball, forcing it forwards in the opposite direction from that in which they grow. When they have reached this size, on everting the lids, the cyst may generally be seen projecting from between some part of the orbital walls and the eyeball; it has usually a bluish tint, and fluctuation may be felt in it if the cyst happens to have fluid contents. Follicular cysts, however, often enclose sebaceous-like matter, when of course no fluctuation can be detected. In doubtful cases, we should do well to use an exploring needle before deciding as to the nature of the disease.

Bluish tint. Fluctuation.

Explore with a needle.

Treatment.

The Treatment to be pursued in instances of this kind is by no means so simple as might at first sight appear. It is not advisable to puncture the cyst and let out its contents, as they are almost certain to form again; and if the cyst is a large one, hæmorrhage may take place into it, and suppuration ensue—leading, perhaps, to a fatal result from extension of the irritation to the brain. The better course is to remove the cyst as far as that is practicable. Should it extend so deeply into the orbit as to prevent our taking it away entire, we must content ourselves with removing as large a portion of it as possible. To do this, it is often necessary to make a free incision through the eyelid, behind which the tumour projects; in fact, a sufficiently large incision must be made through the lid to expose the tumour fully, and allow the cyst to be dis-

Remove the entire cyst.

sected away. Or, if it should seem more desirable, the outer canthus may be slit up and the lid everted with the same intention.

Hydatid Cysts.

Hydatid Cysts of the orbit are occasionally met with, and these, as they increase in size, must necessarily displace the globe of the eye to a greater or less extent. If the tumour projects between the orbital walls and the globe of the eye, it may be felt as a firm, elastic swelling; and as it generally yields an obscure sense of fluctuation, the case may closely simulate one of chronic abscess. A grooved needle will settle the point; a colourless limpid fluid spouting out through the puncture if the tumour is caused by an hydatid cyst.

Remove contents.

In these cases the cyst must be opened, and the included bag, containing the echinococci, should, if possible, be removed; this done, the cavity in which it has grown will probably very soon close up and cicatrize.*

Sanguineous Cysts.

Sanguineous Cysts are occasionally met with in the orbit, either of spontaneous origin, or as the result of an injury. It is almost impossible to discriminate between a tumour of this description and an ordinary cyst, unless by the exploring needle.

The symptoms and progress of these tumours differ in no way from those of other cystic growths: as they increase in size they cause more or less displacement of the eyeball, and diplopia.

Remove the cyst.

It is seldom sufficient simply to puncture a tumour of this kind, and evacuate its contents, for the tumour is then almost sure to form again. The whole of the cyst should, if practicable, be removed.†

Fibroid Tumours.

Recurrent Fibroid Tumours (sarcoma) are not of unfrequent occurrence in the orbit, and, as far as my experience goes, they usually spring from the periosteum lining its lower and inner angle. They are composed of elongated oat-shaped, caudate nucleated cells, like the so-called fibro-elastic cells, which are found in granulation and embryonic connective-tissue. A fibroid tumour of this kind may take a long time to grow, and in the first instance may be mistaken for a node; but the absence of a syphilitic history and of tenderness in the part would lead us to dismiss the idea of periostitis, while the smooth and softer surface of the growth precludes the supposition of a bony tumour. As the morbid growth increases in size, exophthalmos, or displacement of the eyeball occurs, and gives rise to diplopia.

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* "A Treatise on the Principles and Practice of Ophthalmic Medicine and Surgery," by T. W. Jones, 3rd edit. p. 738. Also *Australian Medical Journal*, No. 10, p. 243: case reported by Mr. P. H. MacGillivray.

† Poland on Protrusion of the Eye: *Ophthalmic Hospital Reports*, vol. i. p. 24.

May be mistaken.

These tumours have often extensive attachments to the walls of the orbit, although they may only appear as a small, hard, and nodulated mass upon an external examination. If allowed to remain undisturbed they continue steadily growing, the skin covering them in course of time ulcerates, an open sore is established, and the patient's health gradually fails.* When, therefore, in such a case our diagnosis is confirmed, and all idea of true cancerous disease excluded by the absence of cachexia and of enlargement of the neighbouring glands, we need not hesitate to advise an early operation with a view to prevent further mischief.

Extensive attachments.

Slowly fatal if not removed.

Treatment.—Extirpation of the entire morbid growth is not only desirable, but it is the only remedy upon which we can rely in these cases; and I would strongly insist on the fact, that the affected bone should be removed, as well as the tumour and parts around it. The necessary incisions must depend upon the situation and size of the tumour, and in most cases it is better to sacrifice the eyeball in the first instance, rather than, in our attempt to save it, to leave a particle of the tumour behind. In most cases also, we shall have to cut away a portion, and it may be a very considerable part, of the orbital walls. There is little difficulty in detecting the rough and diseased bone after the tumour has been torn away from its attachments, and the whole of this denuded bone must be taken away; nor is there much difficulty or danger in such a proceeding, unless the orbital plate of the frontal bone is involved; but even in that case, we must not hesitate to use the bone forceps freely. On more than one occasion, under such circumstances, I

Must be extirpated thoroughly

and unsparingly,

to prevent recurrence.

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* *Medical Times and Gazette*, Remarks by Haynes Walton, p. 87. Jan. 1865.

have removed a part of the orbital plate of the frontal bone, and the whole anterior part of the inner and lower walls of the orbit, with favourable results. In fact, I cannot call to mind an instance in which I have repented of doing too much; but, on the other hand, have seen a recurrent tumour return more than once, in consequence of an over-anxiety to save the eye or walls of the orbit.

Escharotic applications.

If the bones are not involved, I need hardly say that we should leave them alone; but under any circumstances I think the application of the chloride of zinc paste to the wound immediately after the removal of the tumour is advantageous. Subsequently the part may be dressed with the carbolic-acid oil (one part to twenty of olive oil).

Repetition of the operation.

If the tumour returns, we should again attempt its removal; we have a distinctly local disease to deal with, and up to the last are bound to combat it on this principle. Large doses of iodide of potassium have been recommended as an adjunct to the above-described treatment in these cases.*

SCIRRHUS OF ORBIT.

SCIRRHUS OF THE ORBIT is, as far as my experience goes, the most common form of cancer in this situation. We see several fresh cases of this formidable disease every year among the patients in the Calcutta Hospital, whereas the other forms of cancer are rarely met with.

Diagnosis.

Diagnosis.—A satisfactory diagnosis between scirrhus and the recurrent fibroid tumour in the orbit, is hardly possible in their early stages. I have seen undoubted instances of scirrhus, commencing as a hard and almost painless nodule attached to the bony walls of the orbit; nevertheless, this condition is not of common occurrence. Scirrhus in the orbit, as in other parts of the body, constantly extends in the tissues of the part in which it is seated, moving with them when pressed upon, and from the commencement is usually attended with some amount of pain. The morbid growth increases rapidly—there is a marked augmentation in its size in the course of a few months, and then pressure on it causes unmistakable pain. The skin becomes involved, and ulceration having taken place we can no longer be in

Moves with tissues.

Rapid increase.

Ulceration.

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* J. Paget: Holmes's "Surgery," vol. i. p. 505.

doubt as to the nature of the affection, or a small quantity of matter scraped from the surface of the tumour, when placed under the microscope, reveals to us the characteristic structures of this terrible disease. The glands of the neck enlarge, and cachexia advances with rapid strides, terminating in death.

Characteristic cells.

Fatal cachexia.

Treatment.—With regard to the treatment of scirrhus of the orbit, I am opposed to surgical interference in the first stages of the disease; the use of the knife, I believe, accelerates its progress, and the chances are infinitely small of our being able to eradicate the cancer. I have, in the early stages of scirrhus of the orbit, removed the whole of the structures contained within this cavity, leaving its walls entirely bare, and yet the disease has speedily reappeared, and run a very rapid course. I think it better, therefore, to leave the patient alone; the alternative is a fearful one, and it is frequently most difficult to abstain from an attempt to do something for the relief of the sufferer.* A case of scirrhus of the orbit is reported by Mr. G. Lawson, in which, after having excised the globe and tumour down to the orbital walls, he applied the actual cautery over the surface of the wound, and subsequently filled the orbit with strips of lint covered with the chloride of zinc paste. The patient progressed favourably, and eleven months afterwards there were no signs of the return of the disease.†

Removal hurtful,

or useless.

Apparent exceptions.

Cases of this kind seem hopeful, nevertheless they do not deter me from pressing my opinion, as to the advisability of non-interference with the knife in scirrhus of the orbit.

I have lately had a case in point under my care, R. B., aged seventy. This old man has been suffering for the last twelve months, from a morbid growth behind the outer part of the upper eyelid. At first there was some slight amount of redness of the eye, increased lachrymation, and pain in the part, but he took little notice of these symptoms until the tumour had increased to its present size. My house-surgeon kindly

Case.

Tumour of orbit.

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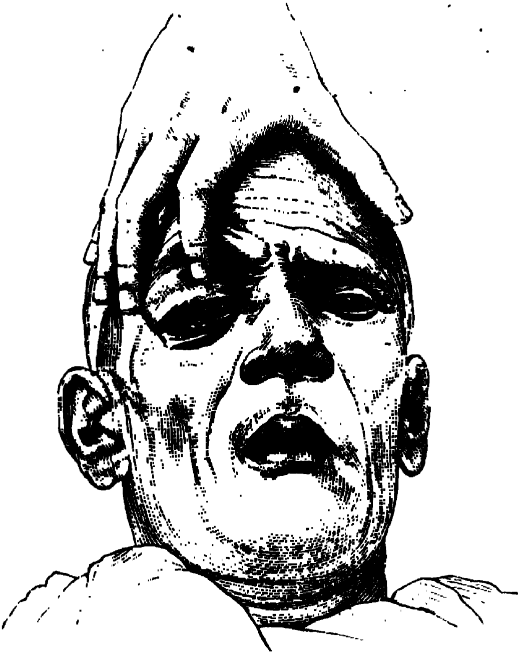
* Tyrrell, "Diseases of the Eye," vol. ii. p. 225. Hasner observes, on the other hand, that we are bound to operate, if it is possible perfectly to remove the neoplasm; this, however, is the difficulty in these cases.

† *Medical Times and Gazette*, Feb. 9th, 1867, p. 155.

got a photograph taken of the patient, from which Fig. 8 is copied.

On admission into hospital a tumour could be distinctly felt, growing from the outer and upper part of the orbit, and pressing the eyeball downwards and inwards. The sight of the eye was perfect, the skin of the lid was not involved, and the tumour felt exactly like an encysted one; so much so, that I determined to operate. I was the more confirmed in this view, as the man had little or no pain in the part, and the glands of the neck were not enlarged; in fact, I undertook the operation supposing I had a non-malignant tumour to deal with.

FIG. 8.



Supposed to be encysted.

Operation. The patient having been put under the influence of chloroform, I slit up the outer canthus and reflected the upper eyelid, so as to expose the morbid growth, which then, and not till then, I discovered to be scirrhus.

Malignancy revealed.

Removal.

The cancerous mass was attached to the orbital plate of the frontal bone, and extended deeply into the orbit. I removed the whole of the tumour, and then applied the chloride of zinc paste to the wound, hoping to save the eyeball.

The day after the operation the cornea was opaque, evidently from the effects of the chloride of zinc, and it ultimately sloughed, and the eye was destroyed.

Unfavourable result.

It is useless my giving the details of the after-treatment in this instance. The wound gradually healed; but before it had cicatrized, the glands of the neck became enlarged, and I doubt not the poor old man speedily sunk from the effects of the disease.

Medullary Cancer of the orbit is characterized by its soft consistence and fungoid appearance, when protruding from the orbit. Its growth is rapid, and it invades all the surrounding structures; of all the tumours of the orbit it is the least hopeful as regards treatment.

Epithelial Cancer.

Following a blow.

Epithelial Cancer is but rarely met with in the orbit. An interesting case of the kind is reported by Mr. Hulke.* The disease made its appearance subsequent to a blow received on the cheek. Six weeks after the accident, the patient presented much the appearance of a person suffering from an abscess, pointing at the lower and inner angle of the eye. The swelling was punctured several times, but no matter escaped, the mass yielding only a soft gelatinous substance. The tumour gradually increased, pressing upon the eyeball on one side, and obstructing the nostril on the other. The skin covering it was of a dusky red colour, and marked with sago-grainlike dots.

Extensive connexions.

After a time a spot of ulceration formed over the caruncle, which bled rather freely, with some relief to the patient; the morbid growth, however, continued to increase in size, and this was accompanied with much pain in the part.

Removal.

Mr. Hulke removed the whole of the morbid mass, which extended downwards into the antrum, and backwards into the left nasal passage, projecting into the pharynx through the posterior nares, so that much of the maxilla, the left nasal bone, and lateral mass of the ethmoid had to be removed.

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* *Ophthalmic Hospital Reports*, vol. v. p. 336.

The tumour presented all the characters of epithelial cancer.

Unfavourable result.

The neighbouring lymphatics became involved, and the disease reappeared in the neck. Ultimately the patient died, eight months after the operation.

MELANOSIS.

MELANOSIS (*Melanoid Cancer*) sometimes attacks the contents of the orbit. Dr. Mackenzie mentions two instances of the kind. When the disease makes its appearance in the orbit, it runs precisely the same course as in any other part of the body, involving the bones and other structures it meets with in its progress.*

A few days before the case of scirrhus above described came under my care, another man presented himself at the hospital, suffering from a melanotic tumour of the orbit:—

CASE.

S. D., aged thirty-two, states that he had a small tumour removed from near the inner angle of the left eye, about four years ago. We can obtain no clue to the nature of this morbid growth. A year after the operation a tumour again commenced growing in the same situation; it caused him no pain.

Growth slow and painless.

At present a morbid growth is seen situated towards the inner part of the orbit, Fig. 9. It has evidently deep-seated attachments, and feels hard to the touch; the skin is not involved. The left eyeball is displaced by the tumour an inch outwards, and fully one inch forwards, from its normal position; nevertheless the eye moves in unison with the other one, and its sight, for both near and distant objects, is perfect. The patient's general health is good, and no enlargement of the glands of the neck exists.

Eye displaced.

Health good.

Removal.

On the 15th of October I proceeded to remove the morbid growth, at the same time endeavouring to save the eyeball.

After making the necessary incisions through the skin, and exposing the tumour, I found that it was attached to the lower, and also to the inner walls of the orbit; I consequently removed not only the morbid growth, but also cut away a considerable part of the bones with which it had been united. Lastly, the wound was filled with lint soaked in the chloride of zinc paste.

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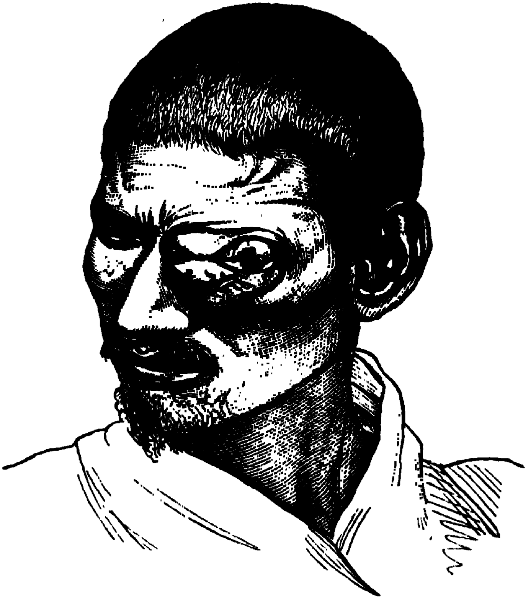
* Case in point by Mr. J. Z. Laurence: *Transactions of Pathological Society of London*, vol. xvi. p. 235.

FIG. 9.



(From a Photograph.)

Caustic applications.

The cornea became hazy immediately after the application of the paste, and subsequently sloughed, the eyeball collapsing; but, excepting this loss of the eye, the case progressed most favourably, and the wound healed and cicatrized. Four years subsequently this patient returned to the hospital; a small bleeding fungoid mass was growing from the site of the original tumour, the glands of his neck were enlarged, but the man appeared otherwise healthy. The excision of the tumour has in this case evidently stayed the progress of the disease, although it has not cured it.

Results.

The morbid growth was a perfectly black mass, about the size of a small orange; it presented to the naked eye, and under the microscope, the characteristics of melanoid cancer.

OPHTHALMIC ANEURISM.

Protrusion and pulsation of eyeball.

"Bruit de diable."

ANEURISM OF THE OPHTHALMIC ARTERY is said to have been met with occasionally.* The quick development of such a tumour, causing the eyeball to be considerably protruded, its pulsating character, accompanied by an aneurismal bruit distinctly audible on placing the stethoscope above the supra-orbital ridge, together with the absence of symptoms indicating any other form of disease—these features would appear to be sufficient for the purposes of diagnosis; but we shall see hereafter, that in cases of this kind, we can never speak very confidently as to the exact seat of the lesion.

Ligature of carotid.

The only treatment we can adopt, with any hope of success, for the cure of an aneurism so situated, is to apply a ligature round the corresponding common carotid artery. We should hesitate, however, to have recourse to so serious an operation, unless pressure made upon the artery either stops, or at any rate lessens, the pulsation of the globe.†

DIFFUSED ANEURISM.

Exophthalmos.

Bruit and pulsation stopped by pressure.

A DIFFUSED ANEURISM has been known to form in the cellular tissue of the orbit, as in other parts of the body, in consequence of an injury, or spontaneously from disease and rupture of a vessel and effusion of blood into the cellular tissue of the part, producing some slight exophthalmos. As the protrusion of the globe increases, the vessels of the conjunctiva become congested and swollen, and the movements of the eyeball are diminished. The eyeball pulsates, and the arterial souffle may be heard in its neighbourhood; this may be stopped if the eyeball be gently pressed back into its socket and the pulsation of the globe ceases at the same time, to be renewed the moment the compressing force is removed. If the pressure is discontinued, the eyeball slowly protrudes to the same extent as before the compression was made.

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* "Lectures on the Operative Surgery of the Eye," by G. J. Guthrie, p. 169; London, 1827. Where a fatal case of true aneurism of the ophthalmic artery on both sides, preventing operation, is recorded.

† Case of supposed aneurism, by Dr. Morton, successfully treated by ligature of common carotid: *Ophthalmic Review*, vol. ii. p. 198. Another case is reported by Mr. Poland, *Ophthalmic Hospital Reports*, vol. ii. p. 219.

Arising from injury

Should the symptoms make their appearance after an injury to the part, we should be led to suppose that an effusion of blood has taken place in the loose cellular tissue of the orbit, and that the clot, having been partly absorbed, has left an aneurismal sac communicating with the injured vessel. In other instances similar changes are said to have occurred after a severe strain, probably not noticed by the patient at the time, but which has caused the rupture of an artery already in a diseased condition, and thus given rise to an aneurism.

or disease of vessels.

On the other hand, we must remember that pulsating tumours of the orbit may occur in consequence of a fracture of the base of the skull, involving the internal carotid artery in the cavernous sinus, and giving rise to symptoms such as those I have above referred to; in fact, increased pulsation of the ophthalmic artery or its branches, as well as obstructions in the ophthalmic vein or cavernous sinus, will produce pulsation of the eyeball.

Diagnosis difficult.

The nature of pulsating tumours of the orbit are consequently very hard to diagnose; and it is more by the careful exclusion of other forms of disease, than by any positive indications, that we can arrive at a satisfactory diagnosis. Compression of the carotid generally causes a marked diminution of the bruit, and is sometimes accompanied by fulness and pain in the head.*

***Treatment.* Ligature of carotid.**

The Treatment of false aneurism in this situation will be the same as that of true aneurism, and consists in tying the corresponding common carotid artery.†

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* *Lancet*, vol. i. p. 473 of 1875, Mr. W. Rivington "On Pulsating Tumours of the Orbit."

† Lawrence "On Diseases of the Eye," p. 766, where two cases successfully treated in this way are recorded, one by Mr. Travers, the other by Mr. Dalrymple. See, also, *Medico-Chirurgical Transactions*, vol. ii. pp. 1—16 and plate, and vol. vi. pp. 111—123.

Digital compression of the carotid has proved successful in a few cases; in one recorded instance it was continued for fifty-six hours without avail. It is advisable when practicable under these circumstances, to raise the carotid and compress it between the fingers, rather than attempt to fix it against the spine. But little dependence can be placed on other remedial measures, yet a remarkable case of aneurism successfully treated by the administration of ergot and veratrium, is reported in the *Ophthalmic Review*, vol. i. p. 288.

ERECTILE TUMOURS. Painless.

Pulsating exophthalmos.

Recedes on pressure.

ERECTILE TUMOURS may form in the cellular tissue of the orbit; they are painless growths, and usually increase very slowly, the patient's health remaining unimpaired. As the vascular tumour augments in volume, it causes more or less exophthalmos, and the prominent eyeball has a pulsating movement imparted to it; this ceases, however, on gentle backward pressure being exercised on the globe of the eye, the eyeball may thus also be made to recede into its normal position. The size of the tumour increases if the patient makes a straining effort, as in crying. If the erectile mass projects forward beneath the conjunctiva, the colour and general characters of the morbid growth will be more apparent, and render the diagnosis comparatively easy.

Ligature of carotid.

Injections.

Treatment.—A case of this kind is probably best treated by ligature of the carotid,* unless the erectile tumour is of small size; we may then be justified in attempting to obliterate the vessels, by means of injections of perchloride of iron, or tannic acid, into the morbid growth; but great care is necessary in a proceeding of this kind, for it is hardly possible to limit the extent or direction in which the injected fluid will run, or to prevent it entering some of the larger vessels: the galvanic cautery would seem to be well adapted for the treatment of erectile tumours in the orbit, a small portion of the growth being dealt with from time to time.

To the foregoing account of vascular tumours in the orbit, it should be added, that they are very rarely met with, and their diagnosis is at all times difficult and uncertain. Cases of pulsating, vascular protrusion of the eyeball, exhibiting most of the features above described, as characteristic of those affections, sometimes present themselves; but in most of them it is doubtful whether the disease is really within the orbit. Several cases of supposed orbital aneurism have proved to be of a different nature, when the opportunity has been afforded of correcting the diagnosis by a *post-mortem* examination, and hence the unavoidable inference that others may have had no better claim to be so regarded. Mr. Nunneley, who has had an unusually large experience in such cases, believes that aneurism within the orbit, whether true or diffuse, is almost unknown. He remarks, that in a large majority of instances of "vascular protrusion of the eyeball, there is no disease whatever in the orbit; the seat of it is mostly intra-cranial. The protrusion of the eyeball is passive, and the other distressing symptoms are secondary, depending on obstruction to the return of the blood through the ophthalmic vein."* Cases are recorded in which all the symptoms of orbital aneurism have arisen from compression of the ophthalmic vein, preventing the passage of blood from the orbit, as for instance, an aneurism of the ophthalmic artery near its origin. It is satisfactory, however, to know that, whether the seat of the tumour be within the orbit or not, the treatment will be the same, and that ligature of the carotid has been successfully practised under these circumstances.†

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* Desmarres records a case in which such a tumour was removed, together with the eye, by Dupuytren: "Maladies des Yeux," vol. i. p. 234.

Fallacies in diagnosis.

Existence of orbital aneurism doubted.

A case, which forcibly illustrates Mr. Nunneley's observations, has been recorded by Mr. Hulke.‡ The patient, five months after receiving a blow on the left side of the head, presented all the capital signs of an orbital aneurism—fulness of the left orbital region—protrusion and pulsation of the eyeball—a distinct sibilant bruit heard extensively in the neighbourhood. The common carotid artery was tied, but the patient

Case in point.

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[*] *Medico-Chirurgical Transactions*, xlviii. p. 30. Previous Cases and Observations, vol. xlii. p. 167.

[†] See a case by Mr. Bell, *Med. Journ.*, July, 1867.

[‡] *Ophthalmic Hospital Reports*, 1859-60, vol. ii. p. 6.

subsequently died, and on making a *post-mortem* examination, phlebitis of the cavernous, transverse, circular, and petrosal sinuses was discovered.

BONY TUMOURS OF ORBIT.

BONY TUMOURS OF THE ORBIT may grow from any part of the walls of the orbit; they most frequently present a nodular form, and are of an ivory-like texture. Sir James Paget is of opinion that they usually grow from the diploë or neighbouring sinuses, as isolated or narrowly attached masses; their tendency being to extend in all directions.

Exophthalmos.

Pain little.

Tumour hard and fixed.

The Symptoms to which an exostosis in the orbit gives rise, will vary somewhat with its position, and the rate at which it grows. The globe of the eye is pushed forwards before the morbid mass, and protrudes to a greater or less extent from its socket. Pain is by no means a prominent symptom in these cases, and frequently we hear no complaints of it from the patient. As soon as the tumour attains a considerable size, it may be felt as a hard, rounded, or spiculated mass attached to the bone, sometimes by a broad base, at other times pedunculated.

Treatment.

Treatment.—It is seldom possible to remove these bony tumours of the orbit, in consequence of their tendency to penetrate into the skull. Nevertheless, instances have been recorded in which tumours of the kind have been cured by nature, the ivory-like mass sloughing away; and it may be well, as Sir James Paget remarks, to expose tumours of this description, by making incisions through the soft parts covering them, and applying, if need be, escharotics to the surface of the bone.*

COMPRESSION OF ORBIT.

Hydrocephalic.

EXOPHTHALMOS FROM COMPRESSION OF THE ORBIT.—The cavity of the orbit may, as I have before remarked, be encroached upon by pressure from without as well as by growths from within. In some remarkable cases of chronic hydrocephalus, the accumulation of fluid within the cranium has been known to force the orbital plate of the frontal bones downwards and forwards, causing the eyeballs to protrude so far from their sockets as to prevent the lids from closing over them. It would be useless to dwell longer on the description of such cases as these, as their nature must be at once apparent.

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* Paget's "Lectures on Surgical Pathology," 3rd ed. p. 536.

Distension of the frontal sinus.

From Diseases of the Frontal Sinuses.—Distension of the frontal sinus is generally caused by a blow on the face which has fractured some of the anterior ethmoidal or frontal cells, and so induced a closure of the infundibulum, preventing the escape of mucus from the sinus into the nares. The secretion of the frontal sinus being in this way retained, gradually accumulates and expands the sinus, often to a very considerable extent. If the malady cannot be traced to an accident, we may assume that closure of the infundibulum has taken place as a result of disease. The symptoms may be either those of active inflammation, or of a chronic character: in the former case the patient complains of great pain over the brow and root of the nose, the frontal sinus becomes rapidly distended with pus and may burst, the pus finding an exit into the nose or upper part of the orbit. When the latter accident occurs, the abscess protrudes from the inner and upper part of the orbit, pushing the eye in the opposite direction. The upper lid is much inflamed, and the protrusion is very tender; fluctuation may ultimately be felt in it.

Symptoms.

Displacement of the eye.

In chronic cases of this disease there may be little or no pain, or other symptom of inflammation; but the gradual formation of a tumour, at the upper and inner part of the orbit, protruding the eyeball downwards, outwards, and forwards. The disease is usually confined to one sinus, but may attack both.

Treatment.

If, from the bulging condition of the frontal bone and pain in the part, we are led to believe that the sinus is so distended with fluid, it will be advisable to cut through its bony walls and allow the pent-up matter to escape.*

In a case recently under my care, I followed out with complete success the plan of treatment recommended by Mr. G. Lawson. He says:—A single curved incision parallel with the fold above the lid is to be made over the most prominent part of the tumour, and having by a little dissection exposed its surface the scalpel should be plunged into it, and an opening made to the extent of the incision. The index finger of the right hand is now to be pushed into the sinus through the wound, to ascertain the size of the cavity and if there is any necrosed or carious bone. Whilst thus exploring the sinus, the little finger of the left hand should be passed up the corresponding nostril, and an endeavour made to find out the spot at which the tip of the finger in the sinus will approximate most closely the end of the one in the nose. After a little search it will be found that at one part the fingers will almost meet, there being only a thin plate of bone between them. Having gained this information, the finger in the frontal sinus is to be withdrawn, but that in the nostril is to be retained *in situ* to act as a guide to the gouge or elevator, which is to be passed into the sinus and made to force a passage into the nose through the lamina of bone on which the tip of the little finger is resting.

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* See the report of a case in which this operation was successfully performed by J. W. Hulke: *Ophthalmic Hospital Reports*, vol. iv. p. 176.

Open the sinus.

Force a passage to the nose.

A communication between the frontal sinus and the nose having been thus established, an india-rubber drainage tube, with holes cut at short distances, is to be introduced, one extremity of which is to be afterwards fastened on the forehead, whilst the other end protrudes slightly from the nostril. The easiest way of introducing the drainage tube is to pass a probe with an eye up the nostril and out of the wound, and having fastened the tube to it by means of a piece of string, to draw it back again through the nose. The object of the drainage tube is to keep the channel between the two cavities from closing, and to enable the attendant to wash out the frontal sinus at least twice a day with some astringent and disinfectant solution. For the latter purpose the lotio alum. cum zinc. sulph., or the lotio acid. carbolic. may be injected with a glass syringe through one of the openings at the upper extremity of the tube. The drainage tube should be worn for five or six months, or until all discharge from the nose had ceased. The

Insert a drainage tube.

results of these cases when thus treated are usually most satisfactory.*

Hydatids and polypi.

Hydatid cysts and polypi have occasionally been met with distending the frontal sinus.†

From Diseases of the Antrum.—The orbital fossa, however, is more frequently encroached upon from below, than from any other direction, in consequence of malignant growths, or the accumulation of fluid within the antrum, forcing the orbital plate of the maxillary bone upwards.

Abscess of antrum.

Abscess of the antrum or an accumulation of its natural secretion from closure of the passage leading into the nose, may distend the walls of this cavity to such an extent, that the hard palate, cheek, and orbital plate of the bone are thrust outwards; and in this way the orbital fossa may be so far encroached upon, as to occasion some protrusion of the eyeball.

Polypus.

A polypus growing from the walls of the antrum, or from the nostril, may, by its gradually increasing size, so far displace either the inner or inferior wall of the orbit, as to lessen the dimensions of the orbital fossa. In these cases the distortion of the face will render the diagnosis comparatively easy; mistakes however do occur: Mr. Poland relates an instance in point; he says, "Only a short time back there was a case where excision of the eyeball was actually proposed for this affection, when it was discovered that the protrusion was due to an abscess in the antrum, which was opened, and the eye saved and resumed its natural place."‡ Such a history as this shows a want of forethought and consideration against which it is impossible to arm individuals, however profuse or practical our rules may be.

Diagnosis.

The following table drawn up by Mr. Poland exhibits the causes of protrusion of the eyeball.§

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* "Diseases and Injuries of the Eye," by G. Lawson, second edition, p. 365; London, 1874.

† Mackenzie "On Diseases of the Eye," 3rd edit. pp. 55—58.

‡ *Ophthalmic Hospital Reports*, vol. i. p. 22. § *Ibid.* p. 22.

Causes of Protrusion of the Eyeball.

- 1\. Congenital
  - 1\. *Real* protrusion.
  - 2\. *Apparent*—from shortening of levator palpebræ and lids.
- 2\. In the eye itself
  - 1\. Inflammation of globe, ophthalmitis.
  - 2\. Phlebitic ophthalmitis.
  - 3\. Hydrophthalmos.
  - 4\. Tumours in eye
    - 1\. Scrofulous.
    - 2\. Encephaloid.
    - 3\. Melanotic.
    - 4\. Osseous degeneration.
    - 5\. Hydatid.
- 3\. Within orbit
  - 1\. Inflammation of cellular tissue—idiopathic and traumatic.
  - 2\. Suppuration and abscess.
  - 3\. Erysipelatous and phlegmonous inflammation.
  - 4\. Foreign bodies.
  - 5\. Excess of development of fat.
  - 6\. Tumours
    - 1\. Encysted.
    - 2\. Hydatid.
    - 3\. Encephaloid.
    - 4\. Osseous.
  - 7\. Aneurism and effusions of blood.
  - 8\. Venous congestion; exophthalmic goitre.
  - 9\. Paralysis of muscles of eyeball—ophthalmoplegia.
  - 10\. Spasm of muscles of eyeball, as in tetanus.
- 4\. External to orbit
  - 1\. Above—Nodes, hydrocephalus, fungus of dura mater, polypi in frontal cells and diseases thereof, tumours of brain, inflammation and diseases of lachrymal gland.
  - 2\. Below—Diseases of the antrum.
  - 3\. Internal—Nasal polypi and tumours.
  - 4\. External—Exostosis.
  - 5\. In front—Contraction of lids, and eyes slipping through, hernia oculi.

DISLOCATION OF THE EYEBALL.

Dislocation of Eyeball.

Dislocation of the eyeball is said to exist when the eye has been forced out of the orbit, as for instance by a foreign body being thrust between it and the orbital walls. I saw an instance of this kind not long since.

Case.

The patient was a sailor, and in a quarrel with a comrade had had his left eye gouged out. The eyeball was hanging down on the poor fellow's cheek, and as the whole of the tissues at the posterior part of the eyeball had been torn from their attachments, and with them apparently the optic nerve, it was useless attempting to save the eye.

Cases are on record, however, where an eye has been dislocated, the patient, for the time being, having entirely lost his sight, but on the eye being replaced in its socket vision has been restored.* Except therefore in cases where we have evidence that the optic nerve has been divided, it will be well to separate the eyelids and restore the dislocated eye to its socket. A firm compress and bandage should subsequently be applied over the closed eyelids, so as to keep the eyeball in its place. If at the end of four or five days the patient has no perception of light, it will be advisable, if practicable, to examine the eye with the ophthalmoscope, and should the retina be detached from the choroid, or the optic disc atrophied, it would be useless attempting to save the eye, and better to extirpate it at once, substituting an artificial eye, supposing the patient can afford the luxury of ornamentation.

Where the nerve is whole,

Replace the eye.

Apply a compress.

If vision lost, remove the eye.

If, on the other hand, the patient has the least perception of light in the injured eye, four or five days after the accident, we must retain it in its place by a pad and bandage for three weeks or so. The firmer the compress can be worn the better, the eyeball being forced back into the orbit by this means, and giving the divided muscles the best opportunity of forming adhesions near the anterior part of the eyeball, so as to reduce, as far as possible, the amount of exophthalmos and diplopia which must result from an accident of this kind.

EXTIRPATION OF THE EYEBALL.

Extirpation of the eyeball may be rendered necessary by the presence of foreign bodies in the eye, or other injuries; by staphyloma, sympathetic irritation, and other diseases. The operation is performed as follows:—

EXTIRPATION OF EYEBALL.

The patient having been laid on the operating table and chloroform administered, a stop speculum or retractors are introduced, so as to keep the eyelids well apart. A fold of conjunctiva having been laid hold of with a pair of forceps, the mucous membrane, sub-conjunctival tissue, and capsule of Tenon are to be cut through all round the cornea, with a pair of slightly curved scissors, so as freely to expose the sclerotic; the straight and oblique muscles are then to be divided close to their insertion

Operation.

Extirpation.

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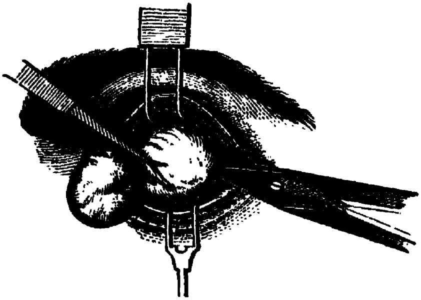
* Mackenzie "On Diseases of the Eye," third edition, p. 13.

into the sclerotic, with a few strokes of the scissors; this manœuvre is facilitated by dragging the eyeball in the opposite direction to that of the muscle whose tendon we are about to divide; there is no necessity to take up each of the recti muscles on a strabismus hook, and divide them one by one, for there is no difficulty at all in cutting through these muscles at their insertion into the globe of the eye, provided the blades of the scissors are kept directly in contact with the sclerotic. The eyeball being thus separated from its muscular attachments, is to be seized and drawn well forward; the curved scissors may then be passed behind it (Fig. 10), and the optic nerve divided close to the sclerotic, together with any other structures which prevent our entirely removing the eyeball.

Fig. 10.



(From Stellwag v. Carion.)

Hæmorrhage trifling.

As a general rule the bleeding after this operation may be arrested, by means of pressure kept up for a short time by an assistant, with a sponge thrust into the cavity from which the eyeball has been removed, and no arteries will have to be tied; but it is well to have ice at hand in case of hæmorrhage. The stop speculum having been removed, cold-water dressing is to be applied over the closed eyelids, and retained there with a light bandage. The use of sutures to bring the edges of the conjunctival wound together are in my opinion quite unnecessary, and, in fact, likely to set up irritation and do more harm than good; compresses of lint or a sponge inserted within the orbit, except for a few minutes as above directed, after the removal of the globe, are not called for to restrain hæmorrhage, and are consequently only to be employed in exceptional cases to stop excessive bleeding.

After-treatment.

The subsequent treatment of these cases is usually very simple: the parts must be kept clean, and to do this properly it will be necessary to open the eyelids from time to time, and syringe out the wound with a little tepid water, or weak solution of carbolic acid. Should inflammation of the cellular tissue of the orbit supervene, it must be treated upon the principles I have already laid down on this subject.

Capsule of Tenon preserved.

It will be noticed that in this operation the globe of the eye is removed from within the capsule of Tenon* (*see* Fig. 1, p. 1) without wounding the cellular tissue of the orbit; the muscles, nerve, and, in fact, the attachments of the eyeball being divided close to the sclerotic. Should the patient wish for an artificial eye, the contracted capsule of Tenon, with the muscles attached to it, forms a very good stump upon which the glass eye may rest.

ARTIFICIAL EYES.

ARTIFICIAL EYES.—An artificial eye is made of a hollow hemisphere of enamel, coloured so as to resemble the front of the other eye.

Advantages of modern practice.

It was formerly the practice in removing the globe of the eye to cut wide of the sclerotic, and in fact to take away the greater part of the contents of the orbit. One of the advantages of the operation of excision, as now performed, is, that the capsule of Tenon, with the attachments of the muscles, is left in the orbit, and forms a moveable stump upon which an artificial eye may rest, and thus move in harmony with the sound one. A still better support is afforded by the operation of abscission, to be hereafter described. (*See* chap. viii.)

Improved stumps.

In some cases, after the eye has been destroyed by purulent conjunctivitis or other causes, we may with advantage fit an artificial eye over the atrophied eyeball.

Adaptation to stump.

Care is necessary in adapting the artificial eye to the requirements of individual cases, and this can best be done by the manufacturer; or a cast of the outer part of the orbit may be made and forwarded for his guidance.

Under any circumstances, the false eye should not be worn until all inflammation and irritation have disappeared.

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* "Lehrbuch der praktischen Augenheilkunde." Von K. Stellwag von Carion. Wien, 1864, p. 553.

How introduced. In introducing it, the upper eyelid must be raised, and while the patient looks downwards, the upper border of the artificial eye should be pushed beneath the lid, which is then allowed to fall: and the lower one being in turn depressed, a little manipulation is sufficient to make the remaining portion of the eye slip into the lower palpebral sinus.

How removed. In removing the artificial eye, the lower lid must be everted, and the thumb-nail, or the point of some instrument, may be introduced under the lower edge of the eye; it is thus lifted away from the remains of the globe, and falls down into the open hand, or upon a soft cushion ready to receive it.

Precautions. After being withdrawn, the artificial eye should be dipped in water and cleansed. Under any circumstances it is liable to get corroded and rough in course of time, and then sets up much conjunctival irritation. Whenever this is the case, or if, independently of changes in the surface of the glass, it causes the patient any inconvenience, it should not be worn; otherwise it may excite dangerous sympathetic irritation in the other eye.

The artificial eye should always be removed at night, and only worn at first for a few hours during the day.

DISEASES OF THE LACHRYMAL GLAND.

INFLAMMATION. Rare. May spread to cellular tissue. INFLAMMATION OF THE LACHRYMAL GLAND may be either acute or chronic; the former is an affection seldom met with. Chronic inflammation of the gland is also a very rare form of disease, occasionally seen among people affected with scrofula. The secluded position of this gland preserves it from injuries by direct violence; on the other hand, it favours the propagation of inflammatory action from the gland to the connective tissue around; and it is thus sometimes impossible to distinguish a case of inflammation of the gland from one of general inflammation of the cellular tissue of the orbit.

Pain. Congestion. *Symptoms.*—In cases of acute inflammation of the gland the patient complains of a severe darting or shooting pain in the orbit, extending over the forehead and side of the head; the conjunctiva and eyelids become intensely congested and much swollen, the globe of the eye being pressed downwards and forwards, or inwards and backwards. These symptoms are usually accompanied with fever. If the inflammatory action advances, fluctuation will soon be felt at the upper and outer part of the orbit, and after a time matter will burst through one or more openings in the upper eyelid, and the abscess having discharged its contents, the swelling and inflammation gradually subside. It sometimes happens, however, that the periosteum, and subsequently the bone in the immediate vicinity of the gland becomes involved, in which case a fistula forms, and remains open so long as the diseased action in the bone continues. In case of chronic inflammation of the lachrymal gland, there is a more or less considerable nodulated swelling at the upper and outer margin of the orbit. The skin is moveable over the swelling, which is but slightly painful, and as it increases in size causes more or less displacement of the eyeball. When in this condition the gland may at any time become acutely inflamed.

Displaced globe.

Suppuration.

Treatment.—In acute inflammation, we may endeavour, in the early stages of the disease, to prevent suppuration by leeches and the application of cold compresses to the part; subsequently, if suppuration appears inevitable, hot poultices should be applied and changed every two hours. It will generally be advisable to administer morphia to allay the constitutional irritation, and the usual diaphoretic mixture may be given if febrile symptoms are present. The earlier an abscess in this situation is opened the better: a free incision must therefore be made in the gland, as soon as fluctuation can be detected. In chronic cases we may try to get absorption of the enlarged gland by means of iodine.

Treatment.

Leeches and cold.

Poultices.

Opium.

Incision.

HYPERTROPHY OF THE LACHRYMAL GLAND is an affection almost peculiar to young people, the subjects of a scrofulous diathesis. Probably one of the first symptoms of which the patient complains is a certain amount of double vision, from the impeded motion of the eye, consequent on the enlargement of the gland. On examination, the hypertrophied gland, which may grow to a considerable size, will be felt behind the outer part of the upper eyelid, and might be mistaken for a malignant growth, but it is painless,

HYPERTROPHY.

Scrofulous.

Double vision.

Slow and painless growth.

and increases in bulk with remarkable slowness.* In the course of time the glandular swelling may gradually decrease and disappear as it came, or it may suppurate, and a chronic abscess result, the discharge from which frequently lasts for months, causing the patient much annoyance, but little or no pain.

May suppurate.

Iodide of iron. Cod-liver oil.

In treating cases of hypertrophy of the lachrymal gland we must depend chiefly upon good food, fresh air, and cod-liver oil, and the iodide of iron, in the hope of promoting the absorption of the tumour. Cases may arise in which it may seem advisable to excise the gland.† If suppuration should occur, we must open the abscess as soon as possible.

Fibro-plastic growth.

FIBRO-PLASTIC AND CANCEROUS GROWTHS.—This gland is occasionally affected by fibro-plastic growths, and by scirrhus or melanosis. The former is characterized by more or less displacement of the eyeball downwards and backwards, and after a time the enlarged gland may be distinctly felt behind the outer part of the upper lid; its growth is painless and usually slow. Should cancerous disease become developed in this situation, we shall, in addition to the above symptoms, have those superadded which are common to malignant disease in other parts of the body.

Cancer.

Question of removal.

The observations I formerly made against the practice of removing scirrhus from the orbit, are equally applicable to malignant disease of the lachrymal gland.

In cases of hypertrophy or fibro-plastic growth, on the other hand, the diseased gland should be excised, otherwise, by long-continued pressure on the eyeball, it may ultimately lead to its destruction.

Excision of lachrymal gland.

Excision of the Lachrymal Gland is thus performed:—An incision is made about an inch and a half long, through the upper lid, parallel to the outer two-thirds of the supra-orbital ridge; the edges of the wound being separated, and the cellular tissue divided, the gland is exposed, together with its accessory lobe, and it may then be separated from its attachments with the handle of the scalpel and removed. Clots of blood should be carefully washed out of the wound,

Operation.

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* Tyrrell "On the Eye," vol. i. p. 504.

† An instance of this kind will be found in the *Ophthalmic Review*, vol. i. p. 163.

and its edges brought together with sutures, cold-water dressings being subsequently applied.

Another method.

Mr. J. Z. Laurence directs that, in excising the gland, a transverse incision of three-fourths of an inch in length should be made into the orbit, over the upper and outer third of the orbital ridge; he then divides the external commissure of the lids with scissors; and by connecting the outer ends of the two incisions, forms a triangular flap, which is thrown up. The lachrymal gland is thus exposed, secured by a sharp hook, drawn forwards, and removed. The edges of the wound are then united by sutures. The linear scar of the incision is subsequently inappreciable, being lost in the folds of the upper eyelid.* The extent of the incision will of course vary with the size of the tumour to be removed.

If the eyeball has been forced from its socket by the morbid growth, a pad should be applied over the lids subsequently to the operation, so as to retain the globe of the eye in its natural position till the tissues around it have retracted to their normal condition.

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* *Medical Times and Gazette,* Sept. 1, 1866, p. 231.

CHAPTER IV.

DISEASES OF THE EYELIDS.

Wounds and Injuries—Inflammation—Ulceration—Tumours—Paralysis—Spasm—Abnormal position of eyelids and eyelashes—Entropium—Ectropium—Trichiasis—Adhesions—Œdema—Emphysema—Styes—Tinea ciliaris—Lice—Herpes—Chrom-hydrosis.

WOUNDS AND INJURIES.

CONTUSIONS. A "black eye."

Treatment.

Arnica.

Rest.

CONTUSIONS OF THE EYELIDS.—A blow on the edge of the orbit of eyelids is apt to be followed by considerable swelling and ecchymosis of the part, a "black eye" being the result. We are frequently consulted in such cases, in order, if possible, to prevent the disfigurement caused by a bruise in this conspicuous part of the face. If the patient applies to us soon after the injury has been inflicted, and before any considerable amount of blood has become effused into the loose cellular tissue of the part, we may generally prevent any further ecchymosis by the application of a piece of lint soaked in a mixture of tincture of arnica and water (one part of the former to eight of the latter), which should be kept constantly applied to the eye; "it promotes the absorption of effused blood, prevents discoloration, and relieves pain and stiffness;"* or a solution of muriate of ammonia, acetate of lead, or ice may be used in the same way; but under any circumstances the eyelids should be kept closed and at rest.

Ecchymosis of the eyelids may be the remote effect of a far more serious injury, and thus it may become a very important indication in cases of blows on the head, where one or more of the bones forming the walls of the orbit have been fractured. In these cases, the position of the primary injury and the tense, swollen, and purple colour of the eyelids, together with the gradual advance of the ecchymosis, point but too clearly to the serious nature of the lesion that has taken place, the blood having been effused under the ocular conjunctiva into the cellular tissue of the eyelid from the seat of fracture. It follows, therefore, that if the lower wall of the orbit is fractured, the ecchymosis will first be noticed beneath the conjunctiva of the lower hemisphere of the globe of the eye, and in the lower eyelid; and conversely, in cases where the orbital plate of the frontal bone has been fractured, it will appear in the upper lid and conjunctiva. In instances of this description, the ecchymosis is but a very small matter, and is worthy of attention simply throwing some light on what might otherwise be an obscure case of injury.

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* "Elements of Materia Medica," by W. Frazer, 2nd edit., p. 278.

Ecchymosis of the lids in fracture of the skull,

an aid to diagnosis.

WOUNDS OF THE EYELIDS.—In simple incised wounds of the lids, the edges of the wound must be brought into apposition with one or more fine silk or silver-wire sutures, and cold-water dressing subsequently applied. The sutures may be removed after two or three days; but until then it is advisable to close the lids with a compress and bandage, the parts being kept perfectly at rest. I need hardly say that an apparently simple cut in the eyelid may be only the external indication of a wound which has penetrated deeply into the orbit; nor need I repeat the caution already given against a too hasty and favourable prognosis in such cases.

WOUNDS.

Simple.

Sutures required.

May mark a deeper injury.

Incised wounds of the eyelids, by dividing the fibres of the levator palpebræ, may destroy the action of the muscle, and render it impossible for the patient to raise the eyelid. In some few cases injury to the lids or supra-orbital region, either from a contused or incised wound, has been followed by paralysis of the levator palpebræ. In other cases, not only has ptosis come on, but this has been attended by gradual loss of sight. In order to explain this connexion, we may presume that some of the branches of the fifth nerve have been injured, that the irritation has extended

May cause ptosis and loss of sight,

from injury to 5th nerve.

thence to the ophthalmic ganglion and carotid plexus, and ultimately involved the sympathetic in the morbid action; a permanently engorged state of the capillaries being thus induced, which interferes with the nutrition of the nervous elements, these become atrophied, and the result is the condition above noticed. However this may be, it is well to bear in mind the fact, that even apparently trivial injuries to the eyelids are sometimes followed by paralysis of the levator palpebræ, or by total loss of sight in the injured eye. Instances of this kind are not to be confounded with those depending upon detachment of the retina, consequent on a blow or fall on the eye; in these cases the loss of sight occurs immediately after the accident, and the ophthalmoscope will generally enable us at once to detect the nature of the injury.

Lacerated wounds,

In the case of lacerated wounds of the eyelids, there may be a little more difficulty in adapting the torn edges of the wound to one another. Having previously been cleaned from foreign substances or clots of blood, they should be brought as accurately together as possible, and retained there by means of sutures, otherwise an ugly scar may result, or a cicatrix of considerable extent, which by subsequent contraction may evert the lid to a greater or less degree. Occasionally, from inattention to these apparently trivial matters, the edges of the wound do not unite, and a slit or button-hole opening through the lid remains.*

require care.

Burns.

Burns.—The eyelids are sometimes damaged by fire, or the explosion of gunpowder, or other combustible material. Our chief care under these circumstances must be to prevent, if possible, the formation and contraction of a cicatrix, which is certain to occur unless the greatest care be taken in dressing the wound. A piece of lint soaked in oil or glycerine containing carbolic acid should be applied over the injured lid, together with a compress and bandage, so as to keep the lids well stretched over the globe of the eye until the wound has healed. The dressing may be changed two or three times a day, the wound being bathed with warm water from time to time, but over-anxiety to see it look clean is often attended with ill consequences.

Mischief from cicatrices.

Method of dressing.

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* Lawrence "On Diseases of the Eye," 2nd edit., p. 89.

It will be well especially to avoid rubbing or daubing the surface of such a wound with a sponge or wet rag: simply changing the dressing night and morning, and reapplying the pad and bandage, will be quite sufficient.

Adhesions between the lids;

Should the edges of the lids be excoriated, they are very apt to grow together, particularly at their inner and outer angles; the eye must then be opened more frequently, and the lids should be separated from one another as far as possible, so as to break down any adhesions that may have formed; the margins of the eyelids must be smeared with an ointment composed of equal parts of glycerine and starch boiled together, cacao butter, or any similar substance, not likely to excite irritation, but which will prevent the raw edges of the lids from coming in contact. In the majority of these cases it will be necessary also to employ a compress, as the free margins of the lids are hardly likely to be injured by mechanical or chemical agents, without the integument covering the eyelids also suffering.

How prevented.

INFLAMMATION OF THE EYELIDS.

ERYSIPELAS OF THE LIDS.

ERYSIPELAS.—The skin of the lids is liable to be attacked by phlegmonous or erysipelatous inflammation, the latter usually extending from the parts around, and not uncommonly following exposure to cold, or suppuration of the lachrymal sac.

Redness, Swelling, Vesicles.

In these cases the lids become red, swollen, and tense; usually a number of small vesicles form on the inflamed surface of the skin, and bursting, give exit to a sero-purulent fluid. The patient complains of a tingling, burning feeling in the part, but seldom of deep pain, unless the cellular tissue of the orbit is affected; he is feverish, his tongue is foul, and the pulse usually feeble. In the majority of instances, the inflammatory action soon subsides and the parts return to their normal condition; but in severe cases the disease extends backwards to the orbit, and may, as I have before described, induce blindness by involving the optic nerve; under any circumstances, in bad or neglected cases of erysipelas, the cellular tissue sloughs and comes away in shreds, often damaging the muscular apparatus of the lid, or destroying a

Pain.

May cause sloughing.

considerable portion of the skin, and thus giving rise to ectropium.

Treatment. Nitrate of silver. Incisions. Tinct. ferri. Stimulants.

Treatment.—In erysipelatous inflammation of the lids, it is advisable to paint the skin over with a solution of nitrate of silver (ʒj to an ounce of water) in the early stages of the disease.[*] This application should extend beyond the limit of the inflamed skin, so as if possible to prevent the diseased action from extending; cold compresses may subsequently be applied. If suppuration has occurred, the skin and cellular tissue of the lids must be freely incised, and subsequently poultices applied, the integument surrounding the affected part having been painted over in the first instance with the tincture of muriate of iron. This medicine should also be administered internally, together with stimulants and beef-tea, as described in instances of erysipelas of the cellular tissue of the orbit.

If erysipelas of this severe type has begun in the eyelids, which it seldom does, it is almost certain to extend to the neighbouring structures, involving the contents of the orbit and spreading to the scalp, though doubtless the early and free application of nitrate of silver over the affected part may happily stop the advance of the disease.

PHLEGMON. Ends in abscess.

PHLEGMONOUS INFLAMMATION most commonly attacks the upper lid, which becomes red, swollen, and of brawny hardness; in this stage it is exquisitely painful, but in the course of a few days matter forms, and finding its way to the surface, the abscess bursts, to the great relief of the patient and the rapid abatement of the symptoms.

Treatment. Arg. nit. Poultice. Open abscess.

Treatment.—If in the early stages of these cases the inflamed part is painted over with a strong solution of nitrate of silver, the advance of the disease may occasionally be prevented; but if suppuration is imminent, poultices must be applied, and the abscess opened as soon as possible, our main object being to prevent the pus from burrowing into and destroying the cellular tissue of the lid, thereby perhaps inducing an extensive cicatrix and ectropion. It is advisable, in making an incision into an abscess of this kind, to cut from within outwards, or in the direction of the fibres of the orbicularis muscle.

SYPHILITIC ULCERATION.

SYPHILITIC ULCERATION of the eyelids may be the effect of either primary or secondary syphilis. The

Primary chancre.

diseased action in the former class of cases usually commences in the conjunctiva, the virus having been directly applied to the part; from this point it gradually invades the skin, and in fact the whole thickness of the lids.

Secondary.

Extends to whole of eyelid.

Syphilitic ulceration of the eyelids is, however, more commonly a secondary affection :[*] I have seen several undoubted instances of the kind, in which the nature of the disease had not been recognised until a very considerable portion of the lid had been destroyed. Under these circumstances the ulceration usually commences at the margin of the lids: at first the skin only is involved, but in the course of time the tarsal cartilage and other structures are affected, so that the whole thickness of the lid is implicated in the ulcerative process; the edges of the wound become everted and thickened, and there is a constant discharge of bloody matter from its surface.

Progress slow,

with few exceptions.

Resists ordinary treatment.

The patient seldom complains of much pain in the part, the progress of the affection being generally very slow; but should the individual be in a weak and emaciated state on the invasion of the disease, it may then make rapid strides, speedily involving the entire eyelid, and causing much greater suffering. In some cases the ulceration is comparatively superficial, the skin alone being affected; in these instances, the course which the disease takes is generally remarkably protracted, and often almost painless. In cases, therefore, where a patient has been suffering from long-continued but steadily advancing ulceration of the eyelids, which has resisted all ordinary methods of treatment, we shall very probably discover that it depends upon a syphilitic taint. The previous history of the case and the concomitant symptoms will, of course, assist our diagnosis.

Treatment.

Mercury at discretion.

Treatment.—It is urged by most surgeons that, whether depending upon primary or secondary syphilis, the best method of treating these cases is by mercury, judiciously and cautiously administered. But it is certainly often necessary to abstain from specific treatment in the first instance, more especially if the patient is in a low state of health; and according to my expe-

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Lawrence "On Diseases of the Eye," 3rd edit., p. 108.

Cod-liver oil, pure air.

rience, good food, a generous dietary, cod-liver oil, pure air and exercise, are as necessary as mercury for the cure of these cases. When, however, the patient is in a fit state of health to be put under specific treatment, the hydrarg. c. creta, combined with soda and quinine, is what I usually prescribe; its action being carefully watched, and the mercury discontinued on the first indication that the system has become affected. In many respects mercurial vapour baths afford a preferable method of administering the drug; but as they sometimes tend to exhaust the system, by the increased action of the skin which they occasion, this is an objection to their use where the patient has been previously in a feeble state of health. Under these circumstances we may conveniently order the mercurial ointment to be rubbed into the patient's arm-pits and thighs night and morning, until the ulcer assumes a healthy appearance, which will usually be the case before the constitutional effects of the drug are apparent.

Mercurial vapour baths.

Local applications.

Probably the most suitable local application we can employ for the ulcers is a lotion composed of five grains of carbolic acid to an ounce of glycerine. Black-wash is often very useful, or an ointment composed of ten grains of sulphate of copper to an ounce of simple ointment.

Change of air and scene.

A change of air and scene should always if possible be obtained, for the chances are that our patient is in a depressed and nervous state as to his condition, especially if he is aware of the cause of it; and to relieve this, there is nothing like variety of scene and occupation, the mind being thus prevented from dwelling too much upon the disease.

Ulcers from inherited syphilis.

Infants of a month old and under, the offspring of syphilitic parents, sometimes suffer from pustular eruptions about the corners of the mouth and eyelids, as well as the anus; the pustules burst, and a scab forms, beneath which an indolent ulcer appears. These children are usually little, puny, wizen-faced creatures, whose lives it is hardly possible to preserve. Their best chance is in a good healthy wet-nurse; and as soon as practicable their arm-pits and thighs should be rubbed every other night with the blue mercurial ointment. The effects of the medicine on the system may be estimated by the amelioration which usually takes place in the condition of the sores; directly the ulcers begin to heal the ointment should be discontinued for a time, but the action of the drug on the system must be prolonged for a considerable period after the ulcers have all healed.

Herpes of the Eyelids.

HERPES ZOSTER.—The skin of the lids, like that of other parts of the body, is sometimes affected with impetigo, leprosy, vitiligo, eczema, and herpes. These require no special notice, except perhaps the last, in which the deeper structures of the eye itself are sometimes affected.

Distinguished from erysipelas.

Herpes zoster is not uncommonly mistaken for erysipelas of the eyelids. Herpes frontalis, however, is always confined to one side of the median line, the eruption appearing only over that portion of the skin which is supplied by the ophthalmic division of the fifth nerve; the vesicles never form, therefore, over the patient's cheek. The pustules are small and numerous; they often, however, become confluent, and their contents dry up into a scab, which subsequently falls off, leaving a scar very much like that seen after smallpox. There is less constitutional disturbance in herpes than in erysipelas. On the other hand, the patient is affected with a peculiar numbness, mingled with pain which is often very severe, and precedes the eruption, the heightened sensibility continuing long after the inflammatory outburst, not passing beyond the median line. The nerves of sensation appear to play an important part in herpes zoster; the peripheral distribution of the fifth, from cold or some such cause, becomes inflamed, and "the eruption succeeds as the result of an extension of the vascular excitement of the cutaneous tissues anatomically related to this network."

Pain relieved by atropine.

The intolerable pain in these cases is perhaps best relieved by a subcutaneous injection of atropine or morphia, as near the supra-orbital foramen as possible. The extract of belladonna and sulphate of quinine may be administered internally, and the acetate of lead lotion applied over the inflamed portion of the skin. In some cases, however, these means fail to remove the pain, and it has even been recommended to divide one or more branches of the nerve, a method of treatment I have certainly never had to practise in cases of this kind.

Mr. Hutchinson holds that if the forehead only is

The iris sometimes affected.

affected, although there will be eruption on the upper eyelid, yet the eye will not suffer. If the eruption appears on the upper part of the nose, there will be slight iritis; while if the tip is affected, the eye will suffer severely. These differences he explains by reference to the anatomical distribution of the ophthalmic division of the fifth nerve, by which the disease is localized. The branch which supplies the tip of the nose is the one which supplies also the ophthalmic ganglion, and through it the structures of the eye.* After the acute symptoms of the disease have passed away, dark brownish scars frequently remain to mark the site of the eruption; their colour subsequently fades into that of the skin around them, but the scars themselves remain like those of small-pox, during the remainder of the patient's lifetime.

Limitation to nerve districts.

CHROM-HYDROSIS.

CHROM-HYDROSIS consists in the supposed excretion of an indigo-blue material from the surface of the eyelids. The colouring matter is easily removed by oil or glycerine, but not by water. This disease mostly occurs among women whose menstruation happens to be disordered, and their general health more or less impaired.

In hysterical subjects.

Authentic case.

A remarkable case of this kind is related by Warlomont,† which was made the subject of most careful investigation, and every means taken to prevent the practice of any deception on the part of the patient; still, the case is hardly satisfactory, and cannot be regarded as affording unequivocal evidence of the existence of this most singular disease, and doubts still exist on the matter. Most surgeons are of opinion, and I certainly agree with them, that chromhydrosis is an invention of hysterical patients, the colouring matter having been applied by their own hands, and being no excretion at all from the skin of the eyelids.

XANTHELASMA PALPEBRARUM.

XANTHELASMA PALPEBRARUM.—These buff or yellow patches, not very unfrequently seen near the inner angles of the eyelids, give the patient considerable uneasiness on account of their appearance. The subject has for some time past engaged the attention of Mr. Hutchinson. He has arrived at the conclusion—

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* *Med. Times and Gazette*, Oct. 19th, 1867, p. 432; see also remarks and cases by Mr. Bowman, *Oph. Hosp. Reports*, vol. vi. p. 1, 1867.

† *Ophthalmic Review*, vol. ii. p. 179.

Mr. Hutchinson's observations.

That xanthelasma never occurs in children; whilst it is fairly common in middle and senile periods of life.

That in a small proportion of very severe cases, jaundice, with great enlargement of the liver, is met with.

The form of jaundice is peculiar, the skin becoming of an olive-brown, or almost black tint, rather than yellow, and the colour being remarkable for its long persistence.

In many cases in which there has been no jaundice, there is yet the history of frequent and severe attacks of functional disturbance of the liver.

Xanthelasma occurs more frequently in females than in males, the proportion being two to one.

In all cases the xanthelasmic patches appear in the eyelids first; and not in more than about 8 per cent. do they ever extend to other parts.

The patches invariably begin near the *inner* canthus, and almost invariably on the *left* side.

It is probable that of the causes mentioned, under which the pigmentation of the eyelids may be disturbed, disorder of the liver is the most powerful; hence the fact that the more extensive cases are usually associated with hepatic disease.*

TUMOURS OF THE EYELIDS.

EPITHELIAL CANCER.

A wart at first

Subsequent ulcerations.

EPITHELIAL CANCER.—The lower lid seems to be peculiarly susceptible of this form of disease; it seldom appears before an individual has reached the age of forty, and may commence as a small wart-like growth in the skin over the lachrymal sac, and gradually extend to the lower lid. At first the affection appears so insignificant, and so closely resembles an ordinary wart, that probably little notice is taken of it. After a time, however, the pimple or wart-like growth ulcerates, and a small indolent sore, with raised edges and a glassy-looking surface, appears.

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[*] *Lancet*, vol. i. 1871, p. 410.

Sooner or later other ulcers form near the original one, and, running together, an unhealthy sore, with a red uneven base, results. The disease advances very slowly, and the original sores often appear for a time to have healed, a thin cicatrix forming over them, but which is soon broken through by the exudation of a serous fluid from the ulcerated surface. After a time the diseased action extends itself deep into the corium; it is not always attended with pain, but a tingling, itching feeling exists in the part. The disease also spreads laterally, gradually involving the lower lid, and skin of the cheek, in a mass of ulceration, from the surface of which there is a constant sanious discharge.

Advance slow.

Little pain.

Extends in depth and breadth.

The ulcers in their early stages often appear dotted over with a number of little granules, in appearance like millet seeds, or boiled grains of sago; but the essential feature of the disease in this situation consists in the abnormal production of cells; these are generally nucleated, flattened, thin, and scale-like; for the most part being round or oval in shape, their outline irregular, at some parts linear or angular, or extended in processes. They may be recognised under the microscope from an early period of the disease.*

Characteristic cells.

The importance of forming a correct diagnosis in cases of this description cannot be over exaggerated; for epithelial cancer, situated in any accessible part of the body, may be effectually cured, if completely extirpated by means of the knife in its early stages. Epithelioma might be mistaken for syphilitic, lupoid, or rodent ulceration; the two former are amenable to medical treatment; the latter, like epithelial cancer, can alone be cured by removing the whole of the diseased structure.

Diagnosis most important.

Some years ago, I was consulted by the late Rev. A. S., of Tirhoot, on account of a small wart-like growth about the size of a split pea, situated on the skin at the inner angle of the left eye; its surface was ulcerated, and there were several millet-like bodies scattered over the base of the sore. Mr. S. told me he had then been troubled with this spot for some eighteen months, and that it would not heal. His father had died from what

Illustrative case.

History.

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* *Ophthalmic Review*, vol. i. p. 270. · Cases from Arlt's Clinic.

appeared to have been cancer of the face. I scraped away a little of the tissue from the surface of the ulcer, and having placed it under the microscope, found distinct evidence as to its nature; and I therefore at once removed the abnormal growth, carefully excising a portion of the sound skin round it, and also the subcutaneous structure upon which it grew. At the time of my patient's death, which occurred from fever some five years after the operation, there had been no return of the disease. I mention this case to show the importance of making an early examination of the elementary structures of a morbid growth of this kind.

Early removal successful.

In the more advanced stages of epithelial cancer—in fact, when the whole of the eyelid and part of the cheek have become a mass of disease, it is still advisable to remove it, applying a strong solution of chloride of zinc to the surface of the wound. Apparently hopeless cases are recorded, in which this practice has been followed by satisfactory results. If the disease is left to run its own course, the patient must inevitably sink under it.

Later removal.

Scirrhus.

SCIRRHUS and other forms of cancer occasionally spring from the eyelids, but as they differ in no respect from similar growths in other parts of the body, it is not necessary for me to follow up the subject in this work.

Rodent cancer.

Rodent cancer most frequently attacks the skin of the lower eyelids, but I never remember seeing a case of the kind among the natives of India; the disease usually begins as a dry wart, and after the excrescence has been shed several times the skin ulcerates. The ulcer spreads, involving all the neighbouring structures; it has usually a well-defined border; the surface of the sore is devoid of granulations, and glazed. There is very little discharge from the ulcer unless it happens to become inflamed. Rodent ulcer seldom appears until after middle age. The disease must be entirely removed by means of the knife, and the surface of the wound subsequently smeared over with the chloride of zinc, so as if possible to destroy the whole of the morbid growth.

Warts.

WARTS not unfrequently grow from the skin of the lid, and if near its free margin, they may press upon, and bend some of the cilia inwards against the eye-

Remove at once.

ball. The sooner, therefore, a wart so situated is removed the better; it is useless to waste time in applying caustic, it should at once be snipped off with a pair of scissors.

HORNY GROWTHS.

HORNY EXCRESCENCES are now and then met with springing from the skin of the lids; they seem to depend upon the secretion from a sebaceous gland becoming hardened, and fresh exudations taking place over it; layer after layer of the sebaceous matter thus drying over the original deposit, the horn-like mass at length becomes of such a size as to disfigure and inconvenience the patient considerably.

Remove with scissors.

The same plan of treatment is to be adopted as in the case of a wart: the excrescence, and the skin from which it appears to grow, being snipped off with a pair of curved scissors.

MILIUM,

MILIUM.—Accumulations of sebaceous matter occasionally occur in the ducts of the subcutaneous glands, forming little tumours on the fore edge of the eyelids, resembling minute pearls, situated beneath the epidermis. They seldom exceed a pin's-head in size, and frequently form in groups of irregular shapes and dimensions. It is seldom necessary to interfere with minute tumours of this kind; but if it is deemed advisable to do so, the epidermis covering them may be scratched with the point of a knife, and the contents of the cyst squeezed out.

unimportant.

SEBACEOUS TUMOURS, of small size.

SEBACEOUS TUMOURS, only slightly larger than those last described, but which may grow to the size of a split pea, and contain sebaceous matter, are occasionally met with in the skin of the lids, especially among scrofulous children. They may be readily removed by carefully incising the skin over them, and then squeezing the cyst and its contents out of its nidus. The walls of these cysts, however, are by no means thick, and are almost sure to burst in our efforts to remove them, in which case the remains of the cyst should be torn or dissected away from its attachments. If this is not done, the tumour is very likely to appear again; in fact, if left to Nature, the course they usually take is, after growing to a certain size, to burst and give exit to their contents, which speedily re-form so long as the cyst remains intact.

Destroy the cyst.

Larger tumours,

Large sebaceous tumours, similar to those noticed in other parts of the body, sometimes form in the eyelids, most commonly springing from the periosteum of the frontal bone. They generally contain a glairy, fatty matter, and frequently also a number of hairs. Like the other forms of cystic tumours, they give the patient no pain or inconvenience, beyond such as arises, in this particular situation, from their bulk, which is often considerable.

painless but bulky

should be excised,

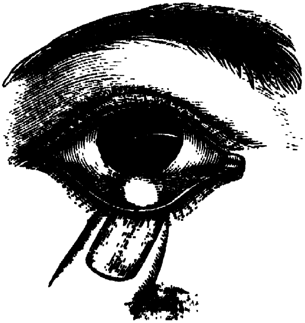
without opening.

In excising a tumour of this kind, it is well to make the incision from without inwards, or in a direction parallel to the fibres of the orbicularis, as the morbid growth is usually situated beneath this muscle. The entire cyst must be carefully dissected away, and it will much facilitate the operation if this is accomplished without opening it. After removing the tumour, the wound must be exposed to the air till all oozing of blood has ceased; its edges may then be brought together with sutures, and painted over with collodion. A pad and bandage must subsequently be applied to keep the parts at rest for a few days. There is then every chance of the wound healing by the first intention, a slight scar only remaining to indicate the position of the incision.

MEIBOMIAN CYSTS.

Their characters

FIG. 11.



(After Mackenzie.)

MEIBOMIAN CYST, CHALAZION, OR TUMOR TARSI.—These tumours arise in the follicles of the Meibomian glands, and are therefore imbedded in the substance of the tarsal cartilage. As they increase in size, they form little painless swellings beneath the skin of the lid, varying in size from a split-pea to a horse-bean. They are unsightly, and induce a disagreeable stiffness of the lids, but beyond this are harmless. On everting the lid from which they spring, the position of the tumour is marked by a circumscribed, yellowish white projection. (*See* Fig. 11.)

May suppurate.

These tumours sometimes become inflamed, and suppurate, without any apparent cause: the abscess, having discharged its contents, the parts return to their normal condition. But, in the majority of instances, it is advisable to evert the lid thoroughly, and the conjunctiva being put on the stretch, so as to render the tumour prominent, a crucial incision must be made into it through the conjunctiva, so that the tumour may be well laid open, and its contents scraped out with a small spatula or curette.

Should be opened.

Immediately after the operation the wound fills with blood, and the size of the tumour may not perhaps appear to have diminished; but in the course of a few days the blood is reabsorbed, and all traces of the tumour disappear.

Water dressing.

There is no necessity for any after-treatment in a case of this kind. Cold-water dressing may be applied over the lids for twenty-four hours, the eyes being closed with a pad and bandage: otherwise the rough surface of the conjunctiva, rubbing against the cornea, may give the patient annoyance. It may subsequently be necessary to attend to the patient's general health, administering tonics, and otherwise endeavouring to improve the tone of his system; for these tumours are likely to follow one another in quick succession, both in the upper and lower eyelids, if the patient is below par.

Improve the general health.

CALCAREOUS CONCRETIONS,

in gland ducts,

CALCAREOUS CONCRETIONS may form in the ducts of the Meibomian glands, and may be felt as small nodulated lines beneath the skin of the eyelid. On everting the lid, the white deposits in the duct may generally be seen beneath the conjunctiva. These concretions give rise to a good deal of irritation by rubbing against the surface of the cornea, inducing hyperæmia of the conjunctiva, which cannot be cured till the foreign substance in the ducts is removed.

The plan of treatment in these cases is to evert the lid and slit open the duct, and then with a spatula or some such instrument, to scrape out its calcareous contents. These concretions are very apt to re-form, especially in districts where the drinking-water contains an unusual quantity of the salts of lime.

to be removed.

FIBROMA.

FIBROMA of the eyelids is occasionally met with as a small bony tumour, of very slow growth, but sometimes being exquisitely painful. A growth of this kind should be removed as soon as possible.

NÆVI.

NÆVI.—A nævus must necessarily be of small size if confined to the eyelids. For the most part, they are of congenital origin; and though, as a general rule, originally situated beneath the orbicularis, the muscular fibres covering them gradually become absorbed, and the nævus then appears as a small, soft, and compressible tumour, situated under the skin, its colour depending upon the preponderance in it of the arterial or venous elements: if the latter are in excess, it presents a bluish appearance. The blood may readily be squeezed out of the nævus, if slight pressure be exerted over its surface; but the sponge-like mass refills and swells up again, as soon as the compressing force is withdrawn. In like manner, a nævus becomes swollen and congested, if the patient strains to any extent, as in the act of coughing or crying.

Deep colour.

Sponge-like character.

Treatment. **Spare the skin.** **Nitric acid.** **Worsted threads.**

Treatment.—Our object is to obliterate the vascular network, of which the nævus is constituted; but at the same time, if possible, to prevent the skin covering it from being destroyed. If this is not provided against, a cicatrix may form, which, in contracting, may evert the eyelid. A small nævus may often be destroyed by puncturing it, and inserting into the puncture a glass pen dipped in nitric acid. I am in the habit of passing two or three worsted threads, soaked in perchloride of iron, through the base of the tumour, and leaving them there for a day or two—in fact, till they have excited some slight amount of inflammation, when they should be withdrawn. The inflammatory action thus set up is often sufficient to obliterate the vessels forming the nævus.

If large, inject with tannic acid,

or perchloride of iron.

If the nævus is of some size, it will be better at once to inject a saturated solution of tannic acid in water into it. Its vessels must first be emptied of blood, a pair of Desmarres' forceps being applied so as to prevent the reflux of blood into the tumour; the point of an hypodermic syringe may then be thrust into the nævus, and the tissue injected with the saturated solution of tannic acid. After a few minutes the forceps should be removed, but, as a general ru[illegible]s well to keep ice applied to the lid for some few hours after the injection; it prevents the inflammatory action from running too high, and, as I have before remarked, sloughing of the skin is to be avoided. A saturated solution of perchloride of iron may be used in place of the tannin, but I think the latter is more to be depended on, and its effects appear to be more uniform than in the case of the perchloride. I have seldom found either one or other of the above modes of treat-

Ligatures.

ment fail to cure a nævus of moderate size; when they are larger, it may be necessary to cut off the supply of blood going to the tumour, by applying a ligature to its base, so as to strangulate the mass, as described by Sir W. Fergusson in his "System of Practical Surgery," to which work I would refer the reader for further details on the subject. Electrolysis has of late been successfully employed for the cure of these nævi; its application is free from pain, and it leaves no scar or disfigurement.

PARALYSIS AND SPASM OF THE EYELIDS.

Ptosis.

Varieties.

Ptosis, or Falling of the Eyelid.—An inability to raise the upper eyelid may occur in one or both eyes from any of the following causes: first, it may be a congenital defect; secondly, it may depend upon a relaxed state of the skin and tissues of the lids; thirdly, ptosis may arise from an injury to the levator palpebræ muscle; fourthly, it may occur from a defect in the nervous apparatus supplying that muscle.

Prevents vision.

From whatever cause arising, a patient suffering from ptosis is unable, by a voluntary effort, to raise the upper lid of the affected eye, but in other respects his vision, and in fact the ocular apparatus may be perfect. If the ptosis is complete, the upper lid, by hanging over the cornea, obstructs the passage of light to the eye; and hence, for all practical purposes the sight is destroyed till the obstruction is removed.

1. Congenital ptosis.

Excise a portion of skin.

Elongate the pupil.

1. In congenital ptosis both eyelids are usually equally affected. For its relief, an elliptical portion of the skin of the lid may be removed (*vide* Fig. 12, p. 106), the edges of the wound being brought together with sutures, and the shortening of the lid thus produced may enable the patient to raise it sufficiently to admit [illegible] rays of light into the eye; but in many of these cases the muscular fibres of the levator palpebræ are almost entirely wanting, and in spite of the above described operation, the lid still droops over the pupil, interfering very much with the perfection of vision. In a case of this description I lately elongated the pupil downwards to the great relief of the patient. Such cases may tax our ingenuity to the utmost, in order to devise means for their amelioration; but, fortunately, this form of ptosis is rare.

2. Ptosis from relaxed tissues.

2. Ptosis, arising from an elongation of the skin and connective tissue of the lids, is a more manageable affection; it seldom occurs except among old people, or those who have suffered from long-continued conjunctivitis. In these cases the connective tissue and skin have been stretched to cover the hypertrophied mucous membrane, while the fibres of the levator palpebræ have become atrophied from senile degeneration. The contractile power of the levator is seldom, however, completely destroyed; and considerable benefit, therefore, frequently arises from excising an elliptical portion of the skin (*vide* Fig. 12), allowing the wound to cicatrize, and in contracting to shorten the lid. The state of the conjunctiva must also be attended to, for in the majority of these cases it is hypertrophied, and, in all probability, will be improved by the application of the dilute red mercurial ointment to its surface twice a day.

Excise a bit of skin.

Ung. hyd. rub.

3. Ptosis from wounds.

3. Wounds and injuries of the levator palpebræ, by dividing or destroying the contractile power of the muscle, are likely to induce ptosis. We may endeavour to rectify this state of things by excising a portion of the skin of the lid; but the loss of power in the muscle will prove a serious obtacle to any permanent amendment. If, as is most probable in cases of this kind, only one eye is affected, it is advisable to elongate the pupil downwards, endeavouring by this means to restore binocular vision.

4. Paralytic ptosis.

4. Ptosis, arising from paralysis of the levator palpebræ, appears occasionally to be the result of an injury to one of the branches of the fifth nerve, probably affecting the motor nerve by reflex action from the quadrigeminal bodies.

Reflex.

Malarious.

The same result may follow malarious affections of the supra-orbital nerve. In these cases the optic nerve and recti muscles are more or less affected, and their functions impaired.

In those more complicated cases, however, where the ptosis seems to depend on a primary affection of the nerve or nervous centre, we may have to exert all our intelligence and skill both in referring the malady to its true cause, and adapting our remedies to the special requirements of the case. We shall do well to bear in mind that syphilis in its various phases is a prolific source of disease, both in the sheaths of the

Syphilitic and other obscure forms.

nerves and in the brain itself; nor must we forget that this form of ptosis may be due to tumours, to limited apoplexy, and many other obscure affections to which the nervous centres are liable.

Ptosis.

Apparently from cold,

In some instances, paralysis of the levator palpebræ is developed suddenly, apparently from the effects of cold. The patient has probably been exposed to a bleak wind, or slept in a damp bed, and the next morning on rising, finds that he cannot open one or other of his eyelids. Many of these cases recover, but in some instances progressive atrophy of the optic nerve supervenes; and it is more than probable that the disease, though attributed to cold or rheumatism, has been in progress for a considerable time, and depends either upon embolism of some of the smaller vessels, or fatty changes in the central axis of the nerve, or nervous centre.

due to degeneration of the nerves or brain.

Treatment.

In the earlier stages of the disease, when of malarious origin, we must not neglect the use of drugs; and we may reasonably hope, by attacking the malarious diathesis in this way, to stop the further progress of the local affection. With this intention, we should try the effect of arsenic combined with iron and strychnine, and other reputed remedies for the cure of malaria.

Drugs.

We may also employ counter-irritation by an issue, or blisters to the temples, as well as administer nervine tonics, iodide of potassium, and so forth, according to circumstances, not neglecting due attention to the condition of the alimentary canal and its secretions.

Blisters, Pot. iod.

In other cases of ptosis, depending for instance on cerebral disease, the wasted muscle may be best excited by means of Faradization.

Faradization.

In employing electro-magnetism for the relief of ptosis, the positive pole may be applied below the ear, and a small piece of moist sponge, connected with the negative pole, over the skin of the closed eyelid. The excitation should be weak, and never continued for more than a few minutes at each sitting. If this mode of treatment is likely to prove beneficial, the amendment generally becomes apparent very speedily. Unfortunately, this form of paralysis is often slow in its development, and being attended by no urgent symptoms, the patient may fail to apply for relief until irreparable damage has been done to the muscles.

PARALYSIS OF THE ORBICULARIS. **Prevents closure of the lids.** **Cornea suffers.**

PARALYSIS OF THE ORBICULARIS PALPEBRARUM is less frequently met with than ptosis. When it exists, the patient may be able to open the affected eyelid, but is unable to close it completely; and the cornea, being more or less constantly exposed to the influence of the air, and of particles of dust which settle upon it, and its nutrition being at the same time impaired, irritation and ulceration are apt to occur. The orbicularis is seldom paralysed alone; in almost all cases the other muscles of the same side of the face, supplied by the seventh nerve, are also affected, the sensation of the part remaining perfect.

Cold, a cause. **Syphilis.**

The most common causes of this "Bell's palsy," as it is called, are exposure to cold, mental emotions of various kinds, and traumatic lesions of the nerve; under any of these circumstances the paralysis occurs suddenly. In other cases the affection is developed slowly, and then usually depends on some lesion of the facial nerve, following syphilitic or other inflammation of its sheath, or of the bony walls of the aqueductus Fallopii; or it may be due to otitis, terminating in necrosis of the petrous portion of the temporal bone.

Disease of brain.

In some few instances the disease commences in the brain. M. Trousseau, in referring to such cases, remarks, that the "orbicularis palpebrarum is never paralysed to the same extent in lesions of the hemispheres of the brain, as it is in disease of the facial nerve; hence, if a hemiplegic patient is asked to shut his eyes, he does it completely enough to hide the globe of the eye, whilst the eyeball remains uncovered in cases of paralysis of the seventh pair."* The pathology of facial paralysis, however, is an extensive subject, and I can only glance at those points in its history which have a direct bearing on the questions before us.

Ulceration of the cornea.

As I have already said, the orbicularis is often involved in facial palsy: consecutive ulceration of the cornea is very apt to occur, and the eye may thus be destroyed; and consequently it is advisable to keep the eye closed with a pad and bandage until the orbicularis has regained its power. Troublesome lachrymation is present from an early stage of the affection, the lower lid no longer forming a canal for the tears; the puncta, moreover, in consequence of the paralysis of the orbicularis, cannot assume their normal position, but drop away from the eyeball, leaving the tears to trickle down over the corner of the eye. Very many cases of facial paralysis recover of themselves; perhaps one of the best tests we possess of the probable result of a case, is to ascertain how the affected muscle responds to the electro-magnetic current. If no contraction of the palsied muscle takes place on being thus stimulated, it is almost a certain sign of the incurable nature of the disease.

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* Baziro's translation of Trousseau's "Clinical Medicine," vol. i. p. 3.

Laehrymation.

Electricity an aid to prognosis.

Treatment.

Although idiopathic facial paralysis generally gets well of itself, the cure may be sometimes hastened by counter-irritation, and exhibition of strychnine, veratrium, and the use of Faradization. In instances of a syphilitic or apparently malarious origin, while employing electricity to excite the muscle into action, we should never fail to administer iodide of potassium, quinine, and other drugs, which appear sometimes to exercise a direct influence on these affections.

BLEPHAROSPASMUS.

BLEPHAROSPASMUS, or spasmodic closure of the eyelids, is an affection of the orbicularis. This muscle is especially liable to spasmodic disorders, the levator palpebræ being but rarely affected.

1. Clonic form.

Nervous winking.

In certain cases of spasm of the eyelids, the contractions are of a clonic kind, so that the patient is constantly winking; or if a portion only of the muscle is involved, a limited twitching is produced. This affection is most common among weak and irritable subjects, and, though unpleasant enough, is generally of no great moment, being readily overcome by a tonic plan of treatment, and the use of a stimulating liniment. There are cases, however, in which such clonic contractions of the lids become a permanent disorder, and these are more troublesome to friends than to the patient himself, who becomes unconscious of, or indifferent, to them.

2. Tonic spasm.

A source of danger,

A far more serious form of blepharospasm is that in which the contractions are of a tonic kind, and either intermittent or continuous. Even when intermittent, the disease is frequently most distressing, and attended with absolute danger to the patient; for he may be seized with a violent spasm of the lids at any moment, entirely destroying his sight for the time; and supposing that he happens to be crossing a crowded street at this particular moment, he runs a risk of being thrown down and run over. Moreover, the affection is in other respects a most painful one, interfering as it does with work, and rendering the patient unfit for all useful employment.

and disabling.

Causes.—Blepharospasm often depends upon irritation reflected from the sensitive to the motor nerve. M. Wecker describes this affection under three heads, according to the source of the irritation:—Firstly, the traumatic; secondly, that depending on disease of the cornea or conjunctiva; and thirdly, upon an affection involving all the branches of the facial nerve.

Reflected irritation.

In the first class of cases, the spasm is generally determined by the presence of a foreign body on the cornea or conjunctiva, the irritation of the branches of the fifth nerve, which is thus produced, being reflected through the seventh or motor nerve to the muscles it supplies. At first the spasm is intermittent, and confined to the orbicularis; but eventually it becomes continuous, and may spread to all the muscles of the face, especially if an attempt be made to open the eyelids by force. At first, perhaps, one eye only is affected, but the other may subsequently become involved.

1. From foreign bodies.

In the second class of cases, the blepharospasm may be caused by the irritation arising from pustular conjunctivitis, or an ulcer of the cornea. The abnormal reflex action thus established, may persist even after the cause of it is removed. To this class we must refer the spasmodic closure of the eyelids in so-called strumous ophthalmia.

2. Pustular conjunctivitis.

The third class includes cases of neuralgic tic of the face, in which the morbid condition of the fifth nerve, especially its supra-orbital branch, is propagated by reflex action to the seventh pair, causing spasm of the orbicularis. Malaria, rheumatism, sudden exposure to cold, irritation of the nerve by bony growths in its passage through the skull, or faulty digestion, may be mentioned as some of the most common causes of this form of blepharospasm.

3. Neuralgic.

The Treatment will of course depend upon the nature of the disease. If the spasm is caused by the presence of a foreign body in the eye, the offending particle must be removed as soon as possible; and so with affections of the conjunctiva, we must endeavour to

Treatment.

Remove local cause.

cure the local disease. But in the third class of cases, we should try to ascertain which of the branches of the fifth nerve is principally involved, and, as a guide to its discovery, we may exert pressure at different points of the surface—for example, over the exit of the supra-orbital nerve, and notice if it influences the spasm of the lid; or, again, we may examine in the same way the inferior dental nerve at the dental foramen. If we can thus discover the point of departure of the irritation among the branches of the fifth, we may very probably, by division of the nerve, interrupt the chain of nervous actions on which the spasm of the orbicularis depends. It may be necessary to divide the nerves on both sides of the face; and at first the beneficial effect of the operation may not be very apparent, but gradually the spasm passes off, to the great relief of the patient. Unfortunately, after an apparent cure has been effected in this way, the disease will sometimes return.

Divide sentient nerve,

on one or both sides.

Among other remedies which may be usefully employed for the relief of blepharospasm, are electricity, the continuous current being used; and also the subcutaneous injection of morphia. These should always be tried before we have recourse to surgical interference. The injection should be made, in the first instance, over the branches of the supra-orbital nerve.

Faradization.

Morphia.

We should never omit to make a careful inspection of the teeth in this form of disease; for the extraction of a carious tooth may remove the blepharospasm. In like manner, the cicatricial tissue of a wound, involving branches of the fifth nerve, may have to be dissected out to relieve the irritation it occasions in the sentient fibres. In fact, careful consideration, and a judicious adaptation of remedies will be called for, to enable us to comprehend and successfully meet the various forms of this very troublesome complaint.

Extraction of teeth.

Dissection of cicatrices.

MALPOSITIONS OF THE EYELIDS AND EYELASHES.

ENTROPIUM.

ENTROPIUM, or an incurving of the margin of the eyelids, may be partial or complete, and may be conveniently divided into two classes—the spasmodic, and permanent.

1. Spasmodic.

The first is seldom met with except amongst old people, whose skin has become lax and wrinkled. We occasionally see cases of the kind resulting from the application of a compress and bandage, as after the operation of extraction of the lens.

Confined to lower lid.

Condition of the parts.

The lower lid is generally affected in instances of spasmodic entropium: its ciliary margin, being curved inwards on itself, carries the cilia with it, so that the latter cannot be seen unless the skin of the lid be retracted, when the cilia assume their normal position; the irregular contraction, however, of the fibres of the orbicularis soon causes the margin of the eyelid to become again incurved. There is not only a lax condition of the cutis in these cases, but the outer fibres of the orbicularis lose their contractile power; whereas those near the margin of the lid, acting with unusual force, turn the cilia inwards in the way described. The eyelashes being thus brought into contact with the cornea, cause such an amount of irritation, that pathological changes gradually take place in its fibrous structure, which end in vascular opacity, or, it may be, destructive ulceration of the cornea.

Irritation of the cornea.

Remove the cause.

Apply collodion or plaster.

Treatment.—Should the entropium have arisen from mechanical causes, as, for instance, after the extraction of a cataract from the pressure of a bandage over the eyelids, it is only necessary to remove the cause, and after a time the orbicularis will regain its functions, and the lid be restored to its normal state. This result may be hastened by first retracting the lid, and then applying a layer of collodion, or a strip of plaster, along its cutaneous surface, so as to keep the lid in its natural position.

Excise a portion of skin.

In the more inveterate cases, whether depending on mechanical or other causes, it will be necessary to excise an elliptical portion of the skin and subcutaneous tissues, parallel to the free margin of the lid; when the contraction of the tissues as they cicatrize will, by shortening the external covering of the lid, retain the ciliary border in its normal position.

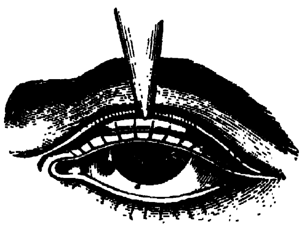
Operation.

One would suppose, from the numerous proceedings propounded, that this was a difficult operation, whereas nothing can be more simple. A pair of entropium forceps should be used to pinch up a fold of the skin, running parallel to the ciliary margin of the lid, which may then be excised with curved scissors (*vide* Fig. 12). The amount of skin to be removed will depend upon the extent of the entropium, and may be judged of by

Avoid the region of the puncta.

noticing if the fold seized between the blades of the forceps is sufficient to restore the cilia to their normal position. Care must be taken to avoid wounding the puncta; in fact, it is seldom advisable to remove the skin towards the inner angle of the eye; for although the punctum may not be wounded, it may be everted by the contraction of the cicatrix, and will thus inconvenience the patient, the tears not being able to escape through the puncta, and a watery eye results. This accident may be avoided by preserving the skin in the situation indicated.

FIG. 12.



2. Permanent entropium, from granular conjunctivitis, or age.

Permanent entropium differs from the spasmodic form, in that the incurving of the lids depends upon changes in their structure, very often caused by granular conjunctivitis. It may also occur, among old people, from the eyeball sinking into the socket; the palpebral border of the orbicularis is then very apt to become inverted. The upper and lower lids are equally subject to this form of malposition, and one or both eyes may be affected.

Cartilage shortened.

Curvature increased.

As I have above remarked, in the majority of cases, permanent entropium results from the effects of granular conjunctivitis, which leads to the formation of cicatrices of the mucous and submucous tissues; these cicatrices in contracting, shorten the tarsal cartilage from side to side, as well as from above downwards, so that the ciliary margin of the affected lid is turned inwards, in consequence of the increase in the natural curvature of the cartilage. The lid affected in this way thus becomes shortened from side to side, and its mucous membrane is generally much hypertrophied; it is evidently impossible, in the presence of so much structural change, to restore the cilia to their normal position by retracting the skin of the lid, as in the spasmodic form of entropium.

Cilia rub against cornea.

In permanent entropium the eyelashes are often destroyed, a few irregular and distorted cilia alone remaining. These stumps, however, by constantly rubbing against the surface of the cornea each time the eye is opened or closed, produce such an amount of irritation, that the transparency of the cornea is gradually lost, and the sight for all practical purposes destroyed.

Entropium from lime.

Occasionally we meet with inversion of the free margins of the eyelids, following the chemical action of lime or some such material falling into the eye, and which has caused sloughing of the conjunctiva, the formation of a cicatrix, and consequently entropium.

Treatment.

Remove or evert the eyelashes.

The Treatment of Permanent Entropium consists in either removing the cilia together with their bulbs, so as to prevent their rubbing against the cornea for the future, or else excising a portion of the skin, and grooving the tarsal cartilage, so as to restore the margin of the lid to its normal position.*

Excision of cilia.

The excision of the cilia and their bulbs is to be managed as follows:—A pair of Desmarres' forceps having been applied to the lid, an incision is made through the skin and subcutaneous tissues, down to the tarsal cartilage, parallel to, and about one-eighth of an inch from the margin of the lid. The extremities of this cut are to be carried down to the free edge of the lid, and the small flap of skin, enclosed within the incisions thus made, is to be dissected away from the tarsal cartilage, together with the subcutaneous tissue and bulbs of the cilia. The wound must be carefully cleaned and examined for any remaining bulbs of the cilia, which should be removed. Cold-water dressing may then be applied till the wound has healed.

Operation for preserving the cilia.

If it is not thought advisable to destroy the cilia, the following operation may be resorted to:—Desmarres' forceps having been adjusted to the lid, an incision is to be made through the skin and subcutaneous tissues, down to the tarsal cartilage, parallel to and about the sixth of an inch from its ciliary border, taking care to keep clear of the bulbs of the eyelashes. A second incision is to be made of the same depth parallel to the first, and about a quarter of an inch from it, and joining it at either extremity. These incisions are then to be deepened, but cutting obliquely downwards into the tarsal cartilage, so as to form a groove in its substance, and the skin, subcutaneous tissue, and cartilage, contained within the above incisions, are to be dissected away. The object of this operation is, in fact, to cut an elongated, wedge-shaped piece out of the skin and tarsal cartilage, so that when the edges of the wound have united, the incurved palpebral margin of the lid will be everted, and resume its normal position. In this operation care must be taken not to wound the puncta, or cause them to become everted by removing the integument about them.*

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* In considering the operative proceedings advocated for the cure of chronic entropium and ectropium, the author has been obliged to confine his remarks to the operations he has himself practised: for were he to attempt to describe them all, it would occupy more space than could be spared in a work of this kind. The reader may consult on the subject "Arch. für Oph." x. 2, p. 221; and the third volume of the *Ophthalmic Review*, p. 299, where A. von Gräfe's method of operating in these cases is described, and, like all the handiwork of that eminent oculist, doubtless demands our attention.

Grooving the tarsal cartilage.

As entropium is frequently complicated and augmented by a shortening of the tarsal cartilage from side to side, it necessarily follows that the longitudinal diameter of the palpebral fissure becomes lessened in these cases; hence, as I shall further explain when describing the mode of treating vascular opacities of the cornea, it is often necessary to elongate the contracted fissure, by slitting up the outer commissure of the eye, as far as the orbital process of the malar bone, and keeping the lips of the wound apart, until their edges have cicatrized; there will then be no fear of their again uniting, and the palpebral fissure will remain permanently elongated.

Shortening of the palpebral fissure.

How corrected.

Operation.

The following is the method of proceeding:—After dividing the external commissure, the edges of the wound must be tied, the upper to a fold of the integument of the forehead, and the lower to the cheek, so as to keep the lips of the incision apart, converting, in fact, the primary horizontal wound into a vertical one. This is represented in Fig. 13, where sutures are supposed to be passed through the thickness of the lid at the extremity of the cut, and tied to folds of skin as above directed. So long as these sutures can be retained, the edges of the incision evidently cannot unite; in practice, however, we find it very difficult to get our patients to submit to this treatment; the pain

Practical objections.

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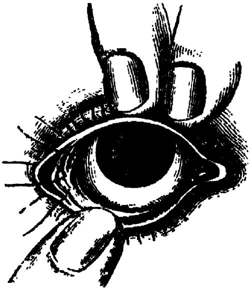
* Streatfeild, "On Grooving the Fibro-Cartilage," *Ophthalmic Hospital Reports*, vol. i. p. 123.

and inconvenience they endure is very great, and though, undoubtedly, the proceeding is most beneficial if it can be carried out, still it is desirable that some simpler means should be devised for attaining the same end. This may be very imperfectly accomplished by slitting up the commissure, and then uniting the conjunctival and cutaneous edges of the wound by means of several sutures.

FIG. 13.



Pagenstecher's method.

Pagenstecher, after dividing the external commissure, takes up a horizontal fold of skin and orbicularis muscle with a pair of forceps, and then passes several ligatures through the base of the fold, allowing them to ulcerate their way out through the skin; the cicatrices thus formed produce permanent eversion of the incurved lid. In passing the ligatures through the fold of skin, the point of the needle is to be entered close to the external surface of the tarsal cartilage, and its point brought out at the edge of the lid; the ligature is to be firmly tied, and allowed to suppurate out, which it generally does in six or eight days. Water-dressing may be applied subsequent to the operation.

Ectropium. **Three varieties.**

ECTROPIUM, OR EVERSION OF THE EYELIDS, may be divided into three classes. 1st. Temporary eversion of the lids, depending usually on purulent conjunctivitis. 2nd. Ectropium arising from hypertrophy of the conjunctiva. 3rd. Ectropium from the contraction of a cicatrix, the skin of the lid having been destroyed either by an injury, or from disease.

1. Temporary. **From conjunctivitis.**

1. The first form of ectropium generally arises under the following circumstances:—In cases of purulent conjunctivitis, the mucous membrane may be so much swollen that the free margin of the lid is forced away from the eye, to such an extent as to become doubled back upon itself, in precisely the same way as if we had everted it for the purpose of examining the palpebral conjunctiva. Under these circumstances the fibres of the orbicularis, at the line of eversion of the

May cause sloughing.

Frequent in children.

lid, form a constricting band, which, by pressing on the vessels, impedes the circulation of blood through them, and the everted conjunctiva may in consequence slough away, irreparable injury being done to the eye. Among young children suffering from purulent conjunctivitis, this form of ectropium is especially likely to occur, the lids having been everted, perhaps in dropping some lotion into the eye, and no trouble taken to restore them at once to their natural position.

Treatment.

Scarification.

Pad and bandage.

The Treatment of this form of eversion of the lids, consists in scarifying the swollen and everted conjunctiva, so as to empty its vessels of blood, after which a little gentle pressure on the swollen lid will reduce the œdema of the part, and the lid may then generally be returned to its natural position with ease, but in some cases may have to be retained there with a pad and bandage applied over the eye for twenty-four hours. The dressing should be removed from time to time, to enable us to clean the eye, and apply the necessary remedies for the cure of the conjunctivitis.

2. Chronic form.

From hypertrophy of conjunctiva.

2. The second form of ectropium, arising from hypertrophy of the conjunctiva, is often thus produced:—Among aged people the skin of the lids becomes lax, and the puncta no longer fit closely against the globe, and the tears are retained in contact with the eye. The lacus lachrymalis being thus always full of tears, considerable irritation of the mucous membrane is excited, and chronic inflammation and hypertrophy of the conjunctiva are ultimately induced; the thickened mucous membrane then forces the lids away from the eye, and ectropium results. The eversion of the lid is usually augmented under these circumstances by inflammation and ulceration of the skin at the inner angle of the eye, caused by the irritation of the tears constantly flowing over it, and the efforts of the patient to keep the part dry.

From paralysis of orbicularis.

Another cause of this form of ectropium—brought about, however, in precisely the same way—is a partial paralysis of the fibres of the orbicularis muscle: the lower lid droops away from the eye, the puncta are everted, and hypertrophy of the conjunctiva and ectropium follow.

Eversion of the lid occasioned by chronic irritation and thickening of the mucous membrane, whether arising from the causes now mentioned or any other—as, for instance, tinea ciliaris—in course of time not only induces a permanent eversion of the tarsal cartilage, but also a lengthening of the lid from side to side. The exposed mucous membrane becomes converted into a thickened reddish mass, assuming very much the characters of the skin. The disease is, therefore, not only very unsightly, but since the patient is unable to close his eye, dust and dirt get lodged on the cornea, and those, together with the contact of the air, produce vascular opacity, and it may be destructive ulceration in the cornea, or even changes in the deeper structures of the eye.

Changes in the cartilage,

and cornea.

Treatment.—In the first instance, in slight cases, we may try the effects of the red precipitate ointment, applied over the ectropium and along the margin of the lids, twice a day. If this does not succeed, the ectropium should be still further everted by traction on the neighbouring skin, and the conjunctiva having been dried, a glass rod, wetted with nitric acid, should be drawn over the surface of the mucous membrane, parallel to and about the eighth of an inch distant from the margin of the lid. Immediately after this application, a stream of water must be syringed over the part, so as to wash away the excess of nitric acid remaining on the conjunctiva; and a little sweet oil having been smeared over the surface, the lid is to be kept carefully closed with a pad and bandage. It will generally be necessary to repeat this application once a week for a month, before the desired result will be attained. The conjunctiva seldom sloughs, as we might suppose it would do, after the application of the acid, but a sufficient amount of contraction gradually takes place in the hypertrophied tissues to overcome the ectropium, and restore the lid to its normal position. It may not happen, however, that even then the lid fits accurately enough against the eyeball to allow the lachrymal secretion to pass through the punctum; and it may therefore be necessary subsequently to slit open the canaliculus, as described in the next chapter. In place of nitric acid, any other escharotic, as, for instance, nitrate of silver, may be employed.

Treatment.

Ung. hyd. ox. rub.

Nitric acid.

How to apply it.

Slitting the canaliculus.

In old standing cases, caustics often fail, and it then becomes necessary to excise an elliptical portion

Excising a portion of conjunctiva.

of the everted conjunctiva, extending along the breadth of the lid, and parallel to its ciliary margin. The amount of conjunctiva to be removed will depend upon the extent of the displacement; in fact, we must excise a fold of the mucous membrane in ectropium, in precisely the same manner as we remove a portion of skin in certain cases of entropium; all that is required is, when the wound heals and contracts, that the everted lid shall be drawn back into apposition with the eyeball. After the operation, the eye must be closed with a pad and bandage.

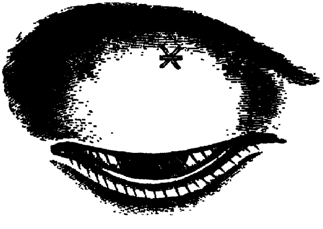
I have already observed that, in old standing cases of ectropium, the tarsal cartilage is apt to become elongated from side to side. In this condition of the parts, it would be useless simply to excise a portion of the conjunctiva; to correct this malposition one of the following operations may be resorted to:—

Another operation.

Fixing the lid by ligatures.

In old cases accompanied by hypertrophy of the long-exposed conjunctiva, we excise with a bistoury, or strong scissors, an elliptical piece of the conjunctiva, proportionate to the degree of hypertrophy of the mucous membrane, parallel to the inferior (become superior) margin of the tarsal cartilage, and one line distant from it. We pass three strong waxed ligatures through the lips of the resulting wound, using a curved needle with a large eye; both ends of each thread are then passed together through the eye of its needle, and the needle is guided along the nail of the left index finger, between the eyeball and the eyelid, made to penetrate the conjunctiva at its angle of reflection from the globe, and brought out as high up as possible through the skin. The two ends of each ligature are then crossed over a bit of plaster, and tied close under the arch of the orbit, as shown in the annexed figure. Chloroform should be given in this operation. Cold compresses must subsequently be employed to keep down the inflammation, and the ligatures removed at the end of three days.*

FIG. 14.



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* *Ophthalmic Review*, vol. iii. p. 113.

In ectropion of the lower lid, caused by elongation of its free border, and also of the tarsal cartilage, the lid must be rendered tense in a horizontal direction, and at the same time lifted up, if we hope to make it fit the eyeball again. The simple narrowing of the palpebral fissure is almost always insufficient.*

Excision of flap from outer angle of eye.

If the ectropion be accompanied by no very great shortening of the integument, and if the margin of the lid is in other respects normal, the excision of a triangular flap, from the outer portion of the lid, and closing the wound by sutures, is generally sufficient. For this purpose the edges of the lids in the outer commissure are slit up with a scalpel. Then a triangular flap of integument is dissected away, as shown in Fig. 15; and the edges of the wound are united by suture, and a protective bandage applied until adhesion has occurred. In order to lessen the stretching, it is well, before closing the wound, to separate the inner edge of the skin from the tissue beneath for a little distance, particularly if the subcutaneous tissue is somewhat thickened from previous irritation. It is also advisable to diminish the tension of the parts by keeping them drawn together by strips of plaster.

If we wish to secure great elevation of the lid and of the commissure, we should close the lids, bring the lower one into a normal position, then the border is put slightly on the stretch in a horizontal direction. We should then mark with ink the two points of both the edges of the lids, where both lid-margins fit each other, when they are in a normal position, and there is a slight amount of tension of the lower lid outwards. Then, the lids being kept in the position described, the integument over the outer commissure is lifted up in a horizontal fold, and as much of the integument of the lower lid very gradually fastened between the fingers as is necessary to bring the lid into its normal position, and to elevate the outer commissure to the level of the inner angle. When the breadth of this horizontal fold of integument is also indicated by two lines parallel to the margin of the lid, we excise the portion of the integument within the described boundaries.

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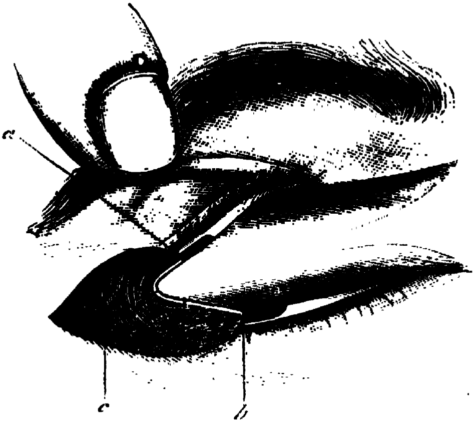
* "Treatise on the Diseases of the Eye." By Carl Stellwag von Carion, translated by C. E. Hackley and D. B. St. John Roosa, p. 402; London, R. Hardwicke, 1868.

Steps of the operation.

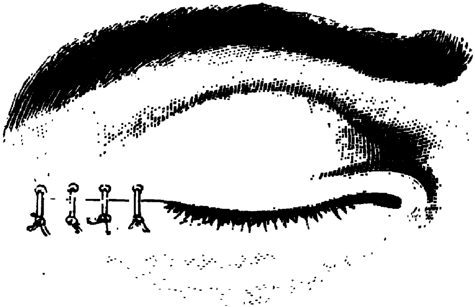
While one assistant holds the head of the patient, and another restrains the bleeding, the operator (*see* Fig. 15) pushes a small horn-spatula under the outer commissure, lifts it up from the globe, and splits it into two layers, first thrusting in a broad, lance-shaped knife immediately in front of the fascia tarso-orbitalis, and then enlarging the wound with a scalpel on both lids, up to the vertical boundary lines *a* and *b*.

FIG. 15.



When this intra-marginal splitting is done sufficiently, the lower and then the upper margin of the lid are pared in a direction inward from the vertical boundary line, for about one-half to three-quarters of a line, by a horizontal incision. The whole breadth of this incision falls behind the lashes. (*See* Fig. 15.)

FIG. 15*.



The horizontal incision is to be made at a greater or less distance from the edge of the lid, according as the outer commissure is to be more or less elevated; but it should always be so made that the two run together at an acute angle. The integument is dissected up, and the wound closed by three or four sutures. The first suture is placed close to the vertical boundary line. (Fig. 15*.)

Subsequent treatment.

In order to lessen the tension, strips of adhesive plaster as well as the protective bandage, may be used. These are fastened on the cheeks and forehead, drawing up the integument lying between them.

When there is a very great difference in the length of the edges of the lids, the result of the operation is endangered by the bulging forward of a large fold of the cartilage and the fascia under the suture. It is, therefore, advisable, after the separation of a circumscribed flap, to cut out a piece of the cartilage next to the outer commissure, whose base is about the same size as the difference in the length of the edges of the lids. The edges of the incision in the cartilage and the fascia should then be included in the suture.

3. Ectropium from cicatrices.

3. Ectropium, arising from the contraction of a cicatrix of the skin, is often a most troublesome deformity to overcome. It matters not if the cicatrix has been formed by a wound or a burn, if it involves the skin of the lid it is almost sure to be followed by ectropium and its consequences. The treatment to be pursued in these cases consists in freeing the lid from the contracting bands of the cicatrix; it is evident that simply excising a portion of the conjunctiva will not effect this object.

Set free the lid.

Operation in slight cases.

In slight cases it may only be necessary to make an incision through the integument, parallel to the ciliary margin of the lid, and of such an extent as will enable us, by dissecting the subcutaneous tissue from the cartilage, to separate it from the adhering cicatrix. The lid, being freed in this way from the cicatricial tissue, may be closed, and should be kept in this constrained position by passing a suture through its edge, and tying it down to a fold of the skin of the cheek, or forehead, according as the upper or lower lid has been operated on; or in some cases, a well-applied pad and bandage will answer the same purpose.

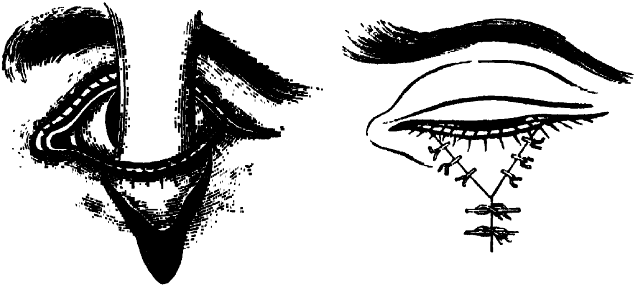
In severer cases.

In more severe cases, the operation recommended by Mr. Wharton Jones should be resorted to. Supposing the upper lid to be everted and bound down to the

Jones's operation.

supra-orbital ridge, Mr. Jones directs* that two converging incisions should be made through the skin, from over the angles of the eye upwards to a point where they meet (*vide* Fig. 16), somewhat more than an inch from the adherent ciliary margin of the eyelid. By pressing down the triangular flap thus made, and cutting all opposing bridles of cellular tissue, but without separating the flap from the subjacent parts, we shall be able to bring down the eyelid nearly into its natural situation, by the mere stretching of the subjacent cellular tissue. A piece of the everted conjunctiva should be snipped off. The edges of the gap left by drawing down the flap are now to be brought together by sutures, and the eyelid retained in its proper place by plasters, and a compress and bandage. Fig. 16 represents this operation for the lower lid.

FIG. 16.



Dieffenbach's plastic operation.

Other surgeons recommend that the cicatrix should be separated from the lid, and a piece of healthy integument, from the cheek or forehead, transplanted into its place. Of the operation proposed, that known as Dieffenbach's is generally to be preferred, though it is almost impossible to lay down any rules strictly applicable to all instances; each case requiring some special modification, which the skill and ingenuity of the surgeon must supply at the time of the operation.

Dieffenbach's operation is performed as follows :—

Dissection of cicatrix.

The cicatrix is first to be dissected away, so as to leave a triangular wound having its base towards the margin of the lid, the line of the ciliary border of the lid and tarsal cartilage being, if possible, preserved. But if these have been destroyed, the conjunctiva alone remaining, it is to be dissected out and laid over the eyeball. The surgeon then makes an incision (*see* Fig. 17), through the sound skin and subcutaneous tissues, extending from one or other of the angles of the base of the triangular wound already made, according to the situation of the cicatrix. From the outer extremity of this incision, a second one is to be carried parallel to the edge of the triangular wound; the enclosed flap is then to be dissected from off the subcutaneous tissue, and being transposed, is to be fitted into the gap left by the cicatrix; the margin of the transplanted skin is then to be carefully united to the edges of this wound by fine sutures. Water dressing should be subsequently applied, and the part kept at rest. The flap may be formed, half from one side of the cicatrix, and half from the other side, but under any circumstances it must be considerably larger than the gap it is intended to fill; in fact, one is hardly likely to err in making too large a flap, but mistakes are often made in transplanting too small a portion of skin.

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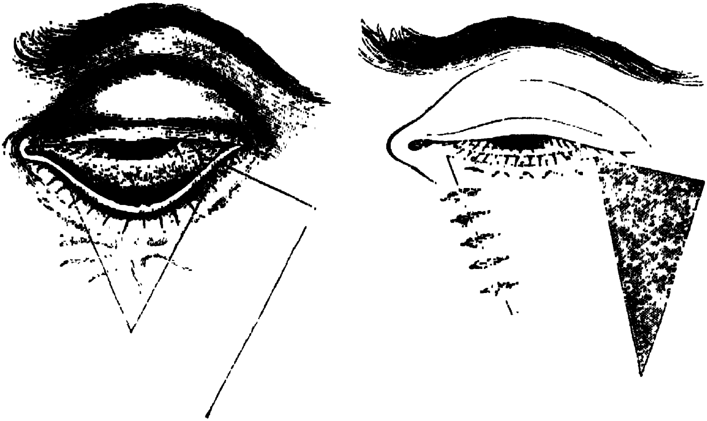
* "Ophthalmic Medicine and Surgery," by T. Wharton Jones, third edition, p. 629.

Transplanting the skin.

Sutures and dressing.

Precaution.

FIG. 17.



As I have before remarked, I can do no more than indicate the principles upon which these operations depend; their details must vary with the particular circumstances of individual cases.

Ectropium from fistula.

Ectropium may be induced by the contraction of a fistulous opening, or rather, from the tissue around the opening contracting, and becoming adherent to the orbital wall. But a fistula seldom occurs in this situation unless as a sequence of disease of the bone, and I need hardly remark, that it is useless attempting to cure the ectropium under these circumstances, until the diseased bone has been removed; it will then be necessary to perform one or other of the operations above described, in order to restore the lid to its normal position. If the eversion is not very considerable, which it seldom is in these cases, the adherent tissues round the opening of the fistula may be carefully dissected away, so as to leave the lid free, and allow of its being dragged away from the cicatricial tissue and the eye closed. The edges of the wound thus made may be brought together with wire sutures, and, as a general rule, it will be well, in addition, to excise a portion of the conjunctiva, so as to insure its contraction. The eyelids must be kept closed, for some days after the operation, with a pad and bandage.

Remove dead bone.

Replace the lid by operation.

Lawson's operation for ectropium.

Mr. Lawson has formed a new eyelid for a patient who had a complete ectropium of the upper lid. He dissected the lid from its attachments, pared at two points the corresponding tarsal margins, and united them by two fine sutures, and thus obtained a fixed level surface upon which to transplant a portion of skin. The parts were then left, and on the fourth day, when the wound was covered with healthy granulations, he transplanted a piece of skin of the size of a threepenny-piece, and two days later another portion, of the size of a silver fourpenny. Both pieces rapidly united to the granulating surface, and the space between them was speedily filled up with new cicatricial tissue. A new lid was thus formed, which was sufficient to protect the eye from exposure: but the presence of two pieces of skin, different in appearance to the ordinary integument of the eyelid, gave the patient a peculiar and rather unsightly look. The skin which was ingrafted not only soon became vascular, but acquired sensibility, and after ten or twelve days could appreciate the slightest touch with a blunt

Forming a new lid.

instrument. The conditions essential for this operation are:—1. That the new skin should be applied to a healthy granulating surface. 2. That skin only should be transplanted, special care being taken that no fat adhered to it. 3. That the portion of skin should be accurately applied to the granulating surface. 4. That the new skin should be kept in position without interruption, and that it should be lightly covered with a layer of lint, and over that a small compress of cotton wool, and a bandage, for the purpose of maintaining its warmth, and thus to assist in retaining its vitality until it had established its new life.

Trichiasis.

TRICHIASIS, OR INVERSION OF THE CILIA, sometimes follows neglected cases of conjunctivitis, or tinea tarsi. Occasionally only a few isolated eyelashes are incurved, the remainder retaining their normal position; at other times the whole of the cilia, or all of those growing from one part of the eyelid, are affected; but under any circumstances the result is the same, the irritation caused by the cilia constantly rubbing against the surface of the eyeball induces chronic conjunctivitis, and, in time, opacity of the cornea and loss of sight. Entropium differs from trichiasis, therefore, in that the ciliary margin of the lid in the former affection is curved inwards, and within the cilia, whereas in trichiasis the lid may be perfectly normal, but the cilia grow inwards against the surface of the eyeball.

Eyelashes grow inwards.

A source of irritation.

The Symptoms to which trichiasis gives rise will depend upon the extent of the disease, and the situation of the inverted hairs; a few of the eyelashes rubbing against the eyeball, at the outer angle of the eye, will not cause nearly so much irritation or inconvenience to the patient as even a single hair, if inverted against the cornea. Cases of trichiasis, if left to themselves, will, in the first instance, give rise to persistent conjunctivitis, followed by haziness, and ultimately vascular opacity, and, it may be, destruction of the cornea.

Conjunctivitis.

Opacity of the cornea.

If only a few of the cilia are incurved, they are very apt to be overlooked, chronic conjunctivitis being the prominent symptom which first attracts our attention. Immediately, however, that the lid is everted, so as to

The cause overlooked.

expose its ciliary margin, the ingrowing eyelashes will be at once detected; it is advisable for this reason, in all cases of even ordinary conjunctivitis, to examine the margin of the lids, and notice if any of the cilia are inverted.

Varieties of trichiasis.

In ordinary muco-purulent conjunctivitis the eye often becomes irritable, and the patient, by constantly rubbing at it, causes one or more of the eyelashes to become inverted, and this greatly contributes to keep up the inflammation. In a case of this kind, all applications will, of course, be useless, unless the offending cilia be removed.

A double row of cilia.

It occasionally happens that people are born with a double row of eyelashes; the inner ones, under these circumstances, are often inverted; this condition is known as *districhiasis.* I mention this variety of trichiasis, not because it presents any special features, but that the meaning of the term may be understood.

Treatment.

The Treatment to be adopted in cases of trichiasis depends very much upon the extent of the disease; if only a few of the cilia are incurved, the offending hairs should be seized one by one with a pair of forceps, and pulled out from their follicles. It is necessary to be careful not to break off the cilia, or the stiff ends left in the eyelid will, by rubbing against the cornea, do more harm than the entire hair would have done. Each cilium must therefore be seized close to the margin of the lid, and slowly and cautiously pulled out, root and all. Unfortunately we cannot extract the hair bulbs in this way, and the consequence is, that another eyelash speedily springs up in place of the one we have removed, and usually takes the direction of its predecessor,—so that if extraction be alone resorted to, it is constantly necessary to watch for the production of new eyelashes in the track of the old ones.

Extraction of cilia.

Care required.

Destroy the hair bulbs,

It is generally advisable, therefore, not only to remove the cilia, but to destroy the bulbs from which they spring. The best way of effecting this is to run a needle, coated with nitrate of silver, through the opening left by the extracted cilia, down to the bulb, which is situated about the sixth of an inch from the ciliary margin of the lid. I usually keep several old cataract needles by me, armed with caustic for this purpose; they are prepared by fusing the nitrate of silver, and then dipping the needle into the fluid; on withdrawing it, it will be found to be coated with a thin layer of the caustic.

with caustic needle.

The lid having been everted, the offending cilia are to be extracted; and the surgeon, keeping his eye on the small hole left in the margin of the lid, thrusts the needle coated with a layer of caustic through it, and down to the hair bulb; the instrument may then be withdrawn. The caustic will excite sufficient irritation of the part to destroy the bulb, and with it the growth of the eyelash. In place of nitrate of silver the needle may be armed with liquor potassæ, or liquefied potassa fusa.

Excision of the bulbs.

Even a dozen cilia may be treated in this way with success; but in old-standing cases, in which perhaps the whole of the eyelashes are incurved, or those of the outer or inner half of the lid are affected, it will be necessary to resort to other means. The whole of the cilia may have to be removed, together with their bulbs, as described in cases of Entropium, page 107, or a portion or the whole of the tarsal cartilage may have to be grooved above the position of the inverted cilia, in order that they may be restored to their normal position. This operation I have found to be particularly useful when the outer half of the cilia are diseased. Occasionally the excision of a portion of the skin of the lid, will evert the palpebral margin sufficiently to prevent the incurved eyelashes from rubbing against the eye; but there can be no doubt, in severe cases, that any proceeding which actually destroys the eyelash and its bulb is to be preferred to an operation which merely everts the palpebral margin of the lid,—trichiasis, as before remarked, not being a disease simply of the eyelid but of the eyelashes.

Grooving the cartilage.

Destroying cilia by ligature. Operation.

Of the operative proceedings intended to accomplish this object, the following is the best* (Fig. 17*):— "A needle is to be threaded with fine silk, and entered between the inner and outer margins of the border of the lid, *a*, and made to pierce the skin a little above the ciliary margin, *b*. The thread is drawn through, and the needle caused to re-enter at the last orifice, *b*,

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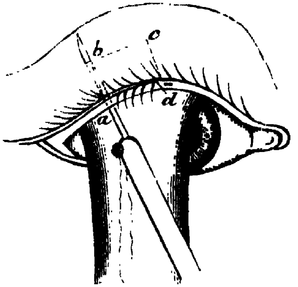
[*] "Illustrations of some of the Principal Diseases of the Eye," by H. Power, M.B., p. 157. Lond. 1867.

and made to run parallel with the border of the lid, for the space in which the cilia maintain the wrong direction (to *c*). The thread is again to be pulled through, and the needle again entered at the last point of emergence, and directed vertically till the point reappears between the edges of the border of the lid, *d*. The two ends are then to be tied, and the thread allowed to cut its way out. The suppuration excited thoroughly destroys the bulbs of the offending cilia, and no further trouble is experienced."

FIG. 17*.



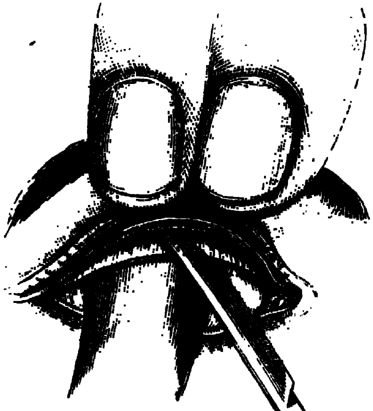
Transplanting the ciliary margin.

In the more inveterate cases of trichiasis, a kind of transplantation of the outer lip of the lid, and the hair follicles beneath, is of great value.

Operation.

It is better to do this operation while the patient is under the influence of an anæsthetic, on account of the great pain it causes, and because of its tediousness. An assistant, who at the same time holds the head, places a horn-spatula under the lid, raises it up from the globe, and causes the edge of the lid to be somewhat everted from the spatula. Then the edge of the lid is divided into layers, for the depth of two lines, with a delicate scalpel (*see* Fig. 17†), the incision not being continued inwards as far as the lachrymal punctum. The posterior layer contains the

FIG. 17†.



conjunctiva, with the cartilage and canals of the tarsal glands, and the anterior includes the remaining structures, with all the hair follicles.

The incision should, therefore, be made close to the surface of the cartilage. Then a second incision is made, one and a half to two lines above, and parallel to the outer lip, completely through the anterior layer, down to the cartilage, and in such a manner that the two ends of the wound extend beyond the ends of the first incision. This layer is thus changed into a kind of bridge, to whose posterior surface the hair follicles are attached, and which is only connected to the lids by the two extremities. When this bridge has been formed, a crescentic incision is made, beginning at the ends of the last incision, through the integument. This is seized with the forceps, and carefully dissected up, without injury to the orbicularis muscle. The size of this flap, should be the larger, and have a greater vertical diameter, in proportion as the hairs are turned inward, and the more the skin is relaxed and wrinkled. The edge of the crescentic incision, and the bridge of skin containing the cilia are now to be brought together by means of sutures; under the traction of these sutures the direction of the hairs becomes horizontal, or is even turned toward the orbital border. The sutures should be removed on the third day.* I have found this operation most useful in many bad cases of trichiasis.

UNION OF EYELIDS.

ADHESIONS OF THE EYELIDS.—The ciliary margins of the eyelids sometimes become united either wholly or in part; this may arise from a congenital defect, or from any cause which gives rise to abrasion of the skin of the free margin of the lids, their raw surfaces growing together, and of course rendering the eye useless for all practical purposes. This is, however, a very rare consequence of disease; it far more commonly follows chemical or mechanical injuries of the parts.

Case.

I have at present a case of the kind under treatment in the Ophthalmic Hospital. Some three months since, the patient was seized by a leopard, the animal inflicting a nasty wound with his claws from the forehead downwards over the left side of the face. The skin of the lids being considerably torn, their inner halves have since grown together, so that the patient cannot now open his eye, and is not only terribly disfigured, but the eye is perfectly useless. In this case, as in most others of adhesion of the margins of the lids arising from mechanical injury, the orbital and palpebral conjunctivæ have also become united.

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* Drs. Hackley and Roosa's translation of Stellwag von Carion on "The Eye," p. 386.

Treatment.

Treatment.—When the margins of the lids grow together, whether from congenital defect or from injury, a director should be passed behind the adhesions, and they should be slit through with a knife or pair of scissors. It will be necessary to keep the lids separated from one another until the edges of the wound have cicatrized.

Complicacations.

Unfortunately, the majority of these cases are complicated with adhesions between the palpebral and orbital portions of the conjunctiva, which it is most difficult to cure. Adhesions of this kind are called *symblepharon*, and are described under the head of diseases of the conjunctiva.

ŒDEMA.

Incidental to various diseases.

ŒDEMA OF THE LIDS is incidental to the progress of various diseases—as, for instance, abscesses, and inflammatory affections of the skin of the face; or more remote ones—such as diseases of the kidneys or heart. But among the poorer class, we often meet with cases of œdema under the following circumstances:—The patient probably states that he had been perfectly well prior to going to sleep, and lay down to rest in some exposed spot. In the morning, to his surprise, he found that he was unable to open his eye, on account of the lids being stiff and swollen; there may have been some pain in the part, but this is not always the case. The eyelids are œdematous, shining, and swollen, but not discoloured; and on forcing them open, the orbital conjunctiva will also be found very œdematous, but not inflamed.

From stings of insects.

This state of things usually arises from one of two causes: either from the sting of an insect, or from the effect of the damp night air blowing over the patient's face. As a general rule, if occurring from the poison of an insect, the point of the sting or bite will be marked by a spot, which is more painful and inflamed than the rest of the swelling; moreover, both eyes are rarely affected in this way.

From cold.

Whereas, when the œdema arises from cold, there is seldom any pain at all in the part, except that caused by the tension and swelling of the cellular tissue of the lid, and both eyes are generally equally affected; nor are the eyelids red and inflamed.

In these cases no special treatment is required; the part may be bathed with a solution of acetate of lead. The œdema generally disappears of itself very rapidly.

EMPHYSEMA.

EMPHYSEMA, like œdema of the eyelids, often depends upon the influence of some remote lesion, as, for instance, general emphysema caused by injury of the lungs, or the admission of air from the nares or frontal sinuses into the cellular tissue beneath the skin of the lids. The part becomes swollen and tense, but not discoloured; and on pressure, the characteristic feeling of crepitation is perceived, depending upon the presence of air in the cellular tissue of the skin.

Treatment.

The Treatment to be adopted in a case of this kind will depend upon the causes which give rise to the abnormal condition of the parts; local treatment will be comparatively useless, but a compress and bandage should be applied over the lids, and retained there till the swelling of the tissues has subsided.

HORDEOLUM, OR "STYE."

HORDEOLUM, or, as it is commonly called, *a stye*, consists of a swelling of a tarsal gland, which inflames and becomes filled with pus. The little abscess is seated therefore in the thickness of the lid, and the integument may be made to glide over it. The swelling varies in size from that of a millet seed to that of a bean; and is hard to the touch. Abscesses of this description generally occur among sickly and debilitated people, and they are far more common among children than adults.

Styes commence with an itching sensation in the part, which soon becomes red and swollen, the lid often being œdematous and very painful.

Treatment.

In the early stages of the disease the eyelash passing through the inflamed spot, should be extracted, and a very fine point of the diluted nitrate of silver should be immediately applied to the mouth of the open follicle; the inflammatory action may frequently be arrested by these means. But if suppuration has occurred, it is better to apply warm poultices to the eye, changing them every second hour; and as soon as the abscess points, the matter may be let out with the prick of a lancet. Tonics are frequently called

Arg. nit.

Poultices.

Tonics.

for, and, unless prescribed, successive styes are apt to appear one after the other, to the great annoyance and discomfort of the patient.

BLEPHARITIS.

Dyscrasial.

BLEPHARITIS, OR TINEA TARSI, essentially consists of an ulcerative inflammation, affecting the lining of the hair follicles of the eyelashes, and is often the result of neglected conjunctivitis; it by no means uncommonly follows an attack of measles, but is most frequently met with among the children of the poor, living in the crowded and dirty parts of our large towns. Under any circumstances it too frequently runs a long and subacute course, unless the greatest attention is paid to the case in the first instance.

Two stages.

Tinea tarsi may be conveniently divided into two stages; in the first, active changes are still going on at the roots of the eyelashes; and in the second, the cilia have been destroyed, and the free margins of the lids are thickened and indurated, presenting the condition known as *lippitudo* or *blear-eye*.

1st stage, "weak eyes."

Symptoms.—The patient complains of what he usually terms weak eyes; they itch a good deal, particularly after work, and on rising in the morning they are often glued together. Symptoms of this kind may have been going on for a long time, inconveniencing the patient a good deal, but not being sufficiently severe to prevent his performing his usual work. Young children are hardly likely to complain at all of their eyes in the early stages of the disease, as there is no actual pain in the part.

Ciliary pimples.

Scabs.

On examining the eyelids of a person suffering from tinea in its early stages, we shall notice a slight crust, or scab attached to a part or the whole of the free margin of the patient's eyelids; beneath these crusts are a number of little pustules also situated on the free margin of the lids at the roots of the cilia: the skin itself is slightly red and inflamed. A constant succession of these pimples form and burst, leaving a scab clinging to the skin with considerable tenacity. The conjunctiva is always somewhat injected.

Lids stick together.

This state of things having lasted for a longer or shorter period, the sebaceous and Meibomian glands become irritable, and their secretion is augmented in quantity and altered in quality, so that the lids stick together during sleep, the patient awaking and finding

Margins ulcerate.

Conjunctivitis.

his eyes glued up in the morning. The skin beneath the scabs at length becomes ulcerated and swollen; the crusts are no longer furfuraceous, but hard and thick, and the eye is very irritable; the patient cannot read or work for even a short time, without the eyes becoming red and painful. In consequence of the swollen condition of the margins of the lids, the puncta are thrust away from the eyeball, and the tears accumulating in the lacus lachrymalis, not only flow over the side of the cheek, but by remaining in contact with the eye induce chronic conjunctivitis; this, in its turn, by presenting a rough surface to the cornea, induces changes in its epithelial layers, not amounting to any perceptible opacity, but sufficient to interfere slightly with the perfection of vision.

2nd stage.

Cilia distorted or shed.

Trichiasis.

"Bleared eyes."

If the disease should advance to its second stage, destruction of the eyelashes and hypertrophy of the free margins of the lids take place, in consequence of the long-continued irritation that has been going on there. It by no means follows, however, that the cilia are completely destroyed; it might be fortunate for the patient if they were; but they frequently drop out, the bulbs of the hairs remaining, and from them distorted, misdirected cilia spring, some of which, turning inwards, produce trichiasis. The surface of the skin beneath the scabs being ulcerated, and discharging a quantity of matter, thick crusts form on the edges of the red and hypertrophied eyelids: at the same time the Meibomian glands become inflamed, and in too many cases the ducts leading from them are ultimately closed, and the disease is then incurable. The margins of the lids are thickened, and the puncta being thus everted, and often closed, the tears stream over the inner corner of the eye: the cornea becomes hazy, and the patient's state is miserable in the extreme, and is made worse by the terrible disfigurement which eyelids such as I have described present.

Treatment.

Treatment.—The treatment of tinea tarsi is complicated by two unfavourable circumstances: the first is, that it most often occurs among children, who are naturally impatient of treatment; and secondly, they are generally the offspring of unhealthy parents. I would here remark that, as a general rule, to cure tinea, we must attack the constitutional infirmity, whatever it may be—whether a syphilitic, or scrofu-

Correct the dyscrasia.

lous dyscrasia, or general debility—upon principles generally applicable to such affections. Among these, probably, pure air, good food, and cleanliness, will take a prominent place. Of drugs, cod-liver oil and iron will prove invaluable.

In conjunction with constitutional treatment, local remedies are most useful: but with children we shall have difficulty in applying them. This difficulty is increased among the poorer classes, while their dirty habits tend directly to induce or foster the complaint.

Remove the scabs.

In the first instance, the scabs on the margins of the lids must be removed with a small spatula, or a cataract needle. In some cases, a poultice or hot compresses should be applied over the lids for a few hours; they will soften the scabs, which may then be detached with a rag and hot water. Having removed all the scabs from the eyelids, an ointment composed of half a drachm of hyd. oxid. flav., to an ounce of unguentum simplex, should be carefully applied along their margins, or the ung. hyd. nitrico-oxidi dil. one drachm, cacao butter three drachms, may be employed in the same way. The chief point, however, to attend to is, that the ointment be brought in contact with the diseased surface: if simply smeared over the scabs, the medications will be almost useless.

Apply mercurial ointment.

After the first application, which the surgeon must effect with his own hands, this ointment should be used twice a day. The patient should bathe the eyes in warm water morning and evening, so as to detach any fresh scabs, before applying it. In a short time we may hope to cure the disease.

In confirmed cases cut off cilia.

In more confirmed cases, where the margins of the lids have ulcerated, the lashes should, in the first instance, be cut off close to their roots, and the scabs removed with a pair of forceps; after which, a pencil of nitrate of silver should be drawn along the outer edge of the ulcerated surface, or we may paint the part over with the tincture of iodine. The surgeon must of course make these applications himself, and subsequently the dilute oxide of mercury ointment may be used by the patient; but the lids will probably have to be painted over with the tincture of iodine twice a week for some time—in fact, till the fungus or parasite, whichever it is upon which tinea depends, is destroyed.

Apply arg. nit. or tinct. iodinii.

Dr. Tilbury Fox recommends carbolic acid dissolved in glycerine to be used in place of the tincture of iodine. I have found this acid most useful in cases of tinea tarsi, employed as above directed, of the strength of one part to five; and subsequently as a lotion, one part of the acid to twenty of glycerine, to be painted along the margin of the lid with a camel's hair brush night and morning.

Carbolic acid.

In most forms of chronic tinea (lippitudo) little can be done to alleviate the disease; the mischief it has effected being, in fact, irreparable. We may, however, remove the bulbs of the cilia, and thus cure the trichiasis, and to some extent the consequent opacity of the cornea. The carbolic-acid lotion will be useful to relieve the ulcerative process; but the thickened, hairless state of the margins of the lids will continue in spite of our best efforts.

Lippitudo incurable.

PEDICULI.—Lice occasionally take up their abode among the cilia, their ova covering the eyelashes, and the cilia looking as if they had been dusted over with a black powder. These parasites give rise to the most intolerable itching of the part, the patient almost tearing the cilia out by their roots; excepting the irritation thus excited, the eye appears to be healthy. On looking carefully at the eyelashes, they seem, as above noticed, to be covered with powder or dust, and with a lens the lice may be distinctly seen. The treatment to be adopted is to wash the parts well with warm water, and then smear the palpebral margin and cilia with staphisagria, and if this fails with the blue mercurial ointment, three times a day. If these remedies do not destroy the lice, a lotion, composed of two grains of hydrarg. bichlor. to an ounce of water, may be employed to bathe the lids.

PEDICULI.

Mercurial applications.

CHAPTER V.

DISEASES OF THE LACHRYMAL PASSAGES.

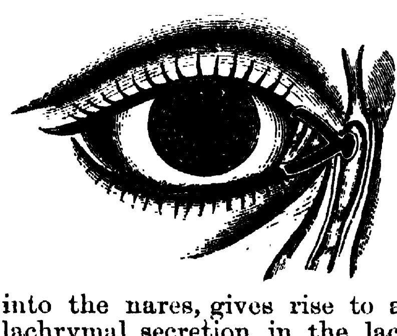
Displacement and obstructions of the puncta and canaliculi—Inflammation of the sac—Obstruction of the nasal duct—Defective secretion of lachrymal gland—Epiphora—Lachrymal cysts and fistulæ.

OBSTRUCTIONS IN THE PUNCTA.

Position of in health.

DISPLACEMENT AND OBSTRUCTIONS OF THE PUNCTA.—In the healthy eye, the lachrymal puncta are in contact with the eyeball, and cannot therefore be seen unless the eyelids are everted. When the eye is closed, the puncta are situated in the lacus lachrymalis, so that the secretion from the surface of the conjunctiva, whether the person is sleeping or waking, can always drain away through the puncta into the canaliculi, lachrymal sac, nasal duct, and so down into the nose. (Fig. 18.)

FIG. 18.



Effects of obstruction;

lachrymation,

Any cause which displaces the puncta, or which obstructs the passage of the tears into the nares, gives rise to an accumulation of the lachrymal secretion in the lacus lachrymalis, which in time overflows, and running down the cheek, causes the patient considerable inconvenience.

Not only is lachrymation thus induced, but a tear is left constantly hanging in front of the cornea, and by interfering with the rays of light in their passage to the eye, renders it necessary for the patient to be per-

conjunctivitis.

petually wiping his eye before he can see clearly; and lastly, the prolonged contact of the tears with the surface of the eye gives rise to chronic conjunctivitis and its consequences.

Causes; inflammation, eversion, inversion.

The most common cause of obstruction to the exit of the conjunctival secretion is inflammation of the lining membrane of the lachrymal passages, producing a stricture in some part of their course. The same effect, however, is brought about if the puncta are prevented from maintaining their normal position, either by the margin of the lids becoming thickened, as in tinea, or from an hypertrophied state of the conjunctiva. Obviously, the same effect will follow ectropium, however induced. On the other hand, it not unfrequently happens that the puncta are too much inverted, when, as in old age, the eye becomes deep sunk into the orbit.

Obstruction of the lachrymal puncta may be either partial or complete—that is, one or both the puncta may be closed, giving rise to symptoms such as I have above described.

Diagnosis by pressure over the sac, and use of a probe.

I mentioned in the first chapter, that if in the healthy eye, pressure were made over the lachrymal sac, a drop of fluid might be observed to ooze out through the lachrymal puncta. Should one or both of them, however, be occluded, it necessarily follows that no fluid can be made to regurgitate through the obstructed orifice. Under these circumstances also we shall find it impossible to pass a probe into the canaliculus. There can, therefore, be no difficulty whatever in arriving at an accurate diagnosis in a case of this kind; and the line of treatment to be followed is no less simple, our efforts being directed to restore the communication between the eye and the nares.

Treatment.

Treatment.—Even in cases of congenital deficiency of the puncta, the normal situation of the opening may generally be detected, a small spot or depression near the inner extremity of the palpebral margin indicating its position; and it by no means follows that because the puncta are closed, the canaliculi are also occluded;

In complete closure,

so that, in some instances, all that is necessary is, simply to cut through the membrane closing the passage into the canaliculus, and keep it open by passing a probe through the passage daily, till the edges of the incision have cicatrized; after which there is but little chance of their growing together, and again obstructing the passage of the tears into the canaliculus.

pierce the membrane.

The lid in which the punctum to be operated on is situated (whether upper or lower) having been everted, a sharp-pointed instrument is to be run through the obstruction in the direction of the canaliculus, the punctum being laid freely open. If a full-sized lachrymal probe can then be passed through the canaliculus into the lachrymal sac, there will be no necessity for any further treatment, beyond the insertion of the instrument through the incision every day, for four or five days, to prevent its edges from uniting.

Pass probe daily.

Supposing we cannot make out the seat of the punctum, it is well to cut across the line of direction of the canaliculus, and then pass a grooved lachrymal director along this canal into the lachrymal sac, slit up the canaliculus throughout its length, and thus leave a free passage for the tears into the sac.

Partial obstructions,

It by no means follows, however, that the puncta are always either completely occluded, or else of their normal calibre; they may be obstructed to any extent between these two extremes, being so far contracted that it is difficult for the lachrymal secretion to find its way through them, in sufficient quantities to keep the corner of the eye free from an accumulation of fluid. Under these circumstances, a very fine probe may be passed through the punctum, and under the guidance of the instrument its inner and upper wall may be incised, and subsequently kept dilated as above described.

similarly treated.

STRICTURE OF THE CANAL.

Permanent.

Causes.

OBSTRUCTION OF THE CANALICULUS may be permanent or spasmodic. A permanent stricture, whether partial or complete, will give rise to the same symptoms as occlusion of the puncta, and for the most part it arises from a similar cause—namely, chronic inflammation of the mucous membrane. A foreign body, as, for instance, a cilium or calcareous concretion, occasionally closes the canal.

The existence of a stricture of the canaliculus is determined by passing a probe through the punctum, when its further passage towards the sac will be prevented by the obstruction.

Caution in using probes.

Particular care should always be taken in exploring the canaliculus; a probe roughly thrust through it may, by wounding the mucous membrane, induce a permanent stricture, even in cases where the obstruction is entirely of a spasmodic character, or arising merely from a congested state of the mucous membrane.

Spasmodic stricture.

Spasmodic stricture of the canaliculus occurs either at the inner or outer opening of the canal, and the watery eye accompanying it may be of an intermittent character, depending on relaxation at one time and spasm at another of the constrictor muscle. There is never the same resistance to the passage of an instrument in cases of this kind through the canaliculus as in instances of permanent stricture.

Treatment.

If recent, delay interference.

In old cases operate at once.

Treatment.—Unless the obstruction is of some standing, attempts should hardly be made to pass an instrument, as the stricture may arise simply from congestion of the lining membrane of the canal, and astringents will cure it; whereas the injudicious use of a probe, by wounding the mucous membrane, may cause a permanent obstruction. On the other hand, if the patient has complained of symptoms of occlusion of the lachrymal passage for some two or three months, it is better, under any circumstances, to operate at once. Old-standing cases of obstruction, from whatever cause they arise, seldom improve under local applications, and the sooner the canaliculus is laid open the better. In practice, however, we so generally find that with obstruction of the canaliculus the nasal duct is also affected, that I now think it better, while opening the former canal, to divide any stricture in the duct, so as to prevent the necessity for a double operation.

1. If incomplete, open the canal on a director.

Pass a probe daily.

1. If the stricture is not complete, a fine grooved director may be passed through it into the lachrymal sac, and an assistant having everted and drawn the lids outwards, a knife must be run along the groove, so as to lay the punctum and canaliculus freely open from end to end. The edges of the incision should subsequently be prevented from uniting, by passing a probe through the wound into the sac every day for a week, after which the channel will remain permanently open, and the lachrymal secretion pass through it into the sac. Care must be taken in this operation to turn the groove of the director inwards, or towards the eye, so that the incision will be in apposition with the eyeball; otherwise the tears will not be able to find

their way into the canal from the surface of the lacus lachrymalis.

Mr. Bowman's operation.

Slitting the canal.

Mr. Bowman describes the above operation as follows:*—The patient sits in a chair, and leans his head against the chest of the surgeon, who stands behind and bends over him. For dividing, for example, the left lower punctum, the ring finger of the left hand is placed on the skin over the lower edge of the orbit, and fixes it there, while tightening or relaxing the lower canal by a sliding movement of the skin upon the bone, the punctum being at the same time everted. The right hand now inserts No. 1 probe while the canal is relaxed, and then places the probe between the index finger and thumb of the left hand, which holds it in the canal, and further everts the punctum by turning the probe downward on the cheek, while the ring finger stretches and fixes the canal by a sliding movement of the skin outwards, towards the malar bone. A fine, sharp-pointed knife, held in the right hand, now slits up the canal on the everted conjunctival aspect, from the punctum, as far as the caruncle, and the probe is raised on its point out of the canal, to make sure that the edge of the punctum has not escaped division. Care should be taken not to slope this little incision obliquely through the tissues it severs, as there is then a broader surface exposed, and greater chance of union by the first intention. To avoid this, it is in all cases desirable to pass a probe across the line of incision, on each of the few ensuing days, to break through adhesions if they form. In some cases, after the canaliculus has been slit open, a small portion of the posterior lip of the wound, near the caruncle, should be taken up with forceps, and removed with scissors, particularly if there is much thickening of the lower lid;† when the puncta are everted, as in ectropium, the incision must be directed well inwards, so as to be in contact with the eyeball, in order that the lachrymal secretion may drain away through it into the sac. Although Bowman's operation is simple enough, nevertheless, in practice it is often by no means an easy proceeding, particularly when we have a nervous patient to deal with; and of

Often difficult to manage.

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* *Ophthalmic Hospital Reports*, vol. i. p. 15.

† Ibid., p. 103.

Slitting the canal and duct open.

late I have almost abandoned the plan of passing a director into the canaliculus, and prefer the following proceeding. The position of the patient, the surgeon, and the part to be operated on will be as above described; but in place of passing a director along the canaliculus a very narrow-bladed knife with a minute probe-like point is to be passed through the punctum, and thrust along the canaliculus; so soon as the point of the instrument touches the inner wall of the lachrymal sac, the direction of the blade of the knife is to be changed from the horizontal to the vertical position; by this manœuvre, the eyelid having been kept lightly on the stretch outwards, the whole length of the canaliculus is divided, and the blade of the knife, without being withdrawn from its position, is to be gently thrust down along the inner wall of the sac and through the nasal duct into the nostril. This proceeding can be effected in very much less time than I have taken to describe it, and it will save subsequent trouble to pass a knife of this kind at once down the nasal duct, and any resisting structures are thus to be divided up to the bony wall of the canal, until the blade of the knife is felt to be free in the duct, and can be turned round or removed up and down without encountering resistance. In the majority of cases, this operation will have to be done sooner or later, and under no circumstances can the proceeding do any harm. This operation is also well adapted for opening the upper punctum and canaliculus. It will be necessary during the subsequent treatment of the case to pass a full-sized lachrymal probe down the nasal duct every two or three days, so as to keep the passage dilated until mucous membrane lining it has healed. (*See Treatment of Fistula Lachrymalis.*)

2. In complete stricture.

2. Supposing, however, that the stricture of the canaliculus is both complete and permanent, so that we cannot pass even the finest director along the canaliculus into the sac, it is evident that we must endeavour to effect another passage for the tears either through the upper canaliculus or from the lacus lachrymalis into the sac, behind the tendo palpebrarum.* The sac having been punctured from this latter direction, the opening must be maintained by passing a probe

Form a fistula to the sac.

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* "Maladies des Yeux," par M. Wecker, tom. i. p. 786.

through it every day, so as to form a fistula between the inner angle of the eye and the lachrymal sac.

Streatfeild's operation.

Mr. Streatfeild's operation may be practised with success in cases where, for instance, the lower punctum is so completely closed that we cannot even recognise its position; he recommends under these circumstances that the upper punctum and canaliculus be divided, and through this opening a fine bent director be passed into the inferior canaliculus, and if possible through the lower punctum; if not the lower canaliculus can the laid open, directed by the probe that has been inserted into it. The converse operation may be performed for closure of the upper punctum.*

PHLEGMON OF THE SAC.

Pain and swelling.

PHLEGMON OF THE LACHRYMAL SAC is attended with great pain, and often gives rise to fever and considerable constitutional disturbance. Phlegmon of the sac commences as a small, hard, and painful tumour, situated at the inner angle of the eye; as the inflammation advances, the skin covering the sac becomes tense and shining, the swelling extending to the cheek and eyelids, which often become so œdematous that it is impossible to open them. At first sight such a case may resemble one of purulent conjunctivitis; the absence, however, of a purulent discharge from the eye, and the excessively painful spot at its inner angle, sufficiently indicate the nature of the disease.

Abscess.

Fistula.

Nasal passage closed.

If the inflammatory action runs on unchecked, suppuration takes place, and fluctuation may be felt over the region of the sac; the matter points outwards, and ultimately discharges itself through an opening in the skin. The inflammation then subsides, and the parts may return to their normal condition. But it too often happens, if the disease is allowed to take its course, that it terminates in fistula lachrymalis. This perhaps closes, and an abscess again forms, so that gradually the mucous membrane lining the sac and nasal duct is partially or completely destroyed, and the passage of the tears into the nose permanently closed.

Occasionally caries or necrosis of the lachrymal bone follows as a consequence of an abscess of the lachrymal sac. More frequently, however, complications of the

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Ophthalmic Hospital Reports, 1860, p. 4.

kind are only met with among scrofulous and syphilitic patients. Phlegmon of the lachrymal sac is by no means an uncommon starting-point for erysipelatous inflammation of the face, extending in all probability to the scalp.

Treatment.

Treatment.—In the early stages of this disease, it is advisable to paint the skin over the inflamed sac with a strong solution of nitrate of silver, and ice or cold compresses may be constantly applied to the part. I never use leeches in cases of this kind, especially among hospital patients; they often do more harm than good.

Arg. nit.

Poultices.

If suppuration has actually commenced, a poultice should be applied over the abscess, and changed every second hour. Supposing the fomentations do not relieve the abscess, so far as to enable us to evacuate its contents through the natural passage by pressure over the sac, we should at once run a probe pointed knife through the punctum and canaliculus into the sac.

Open abscess internally,

If the abscess cannot be opened in this way, the lids should be separated as far as their swollen state will permit; and a cataract knife should be passed with its flat side against the eyeball, and thrust into the tear-sac, in the depression existing between the commissure of the lids and the caruncle. This point can generally be easily reached, especially when the sac is distended with fluid. By this means the abscess is opened and at the same time you save an external wound. In some few instances the swelling of the parts is so great, that it is almost impossible to open the abscess by either of the methods above described, and under these circumstances it is necessary to make an incision directly into the most prominent point of the abscess; its contents are evacuated, and the wound treated antiseptically.

or through the skin.

In spite, however, of all our care, a fistula may form between the sac and the surface of the skin, through which there is a constant discharge of tears: the skin around the opening becomes thickened and excoriated, and from contraction of the integument ectropium may supervene, adding very much to the patient's discomfort.

FISTULA LACHRYMALIS.

FISTULA LACHRYMALIS.—Fistula of the lachrymal sac, as I have shown above, generally arises as a sequence of phlegmon and stricture of the sac. It

Causes.

may, of course, occur from injury or other causes, by which a communication is established between the skin and the sac, and it is often kept open by obstruction of the nasal duct, the lachrymal secretion passing through the puncta and out through the fistula, instead of into the nose.

Treatment.

Treatment.—This being the case, the first and most obvious aim in the treatment must be, to open, if possible, the normal passage for the tears into the nares, by dilating the nasal duct. This was formerly done by passing *a style*[*] through the fistula into the duct, and retaining it there; the passage after a time becomes dilated, and the fistula heals. But the difficulty in this method is to retain the style in the duct; and although various ingenious contrivances have been invented for the purpose, they do not appear to answer, and the style has now been abandoned. In place of it, the lachrymal sac is opened, as I have before described, by slitting up the punctum and canaliculus and gently thrusting the blade of the knife through the sac into the nasal duct and down into the nares.

The "style."

Now little used.

If the surgeon is thoroughly acquainted with the anatomical relations of these parts, he will have but little difficulty in passing a probe through the sac into the nasal duct. The lid should be everted, and by stretching the canal, as before indicated in the operation for stricture, we avoid the risk of forcing a fold of the mucous membrane before the point of the probe, which would prevent the instrument from entering the nasal sac. The probe is then passed horizontally along the opened canaliculus until its extremity reaches the inner bony wall of the sac. The direction of the instrument is then turned vertically, as shown in Fig. 19, and gently passed down through the sac, its point being then directed a little outwards and forwards, it passes into the nasal duct and so reaches the nose.

Slit the canal and pass a probe into the nares.

Indications of stricture.

If the probe is arrested at the point where the canals coalesce and join the sac, the fact may be known by noticing that the skin near the tendo-oculi is moved when the probe is moved, and an elastic resistance is experienced; whereas, if the probe has entered the sac, it hits against the inner bony wall, and the skin is motionless.* If we find an obstruction of this kind preventing the probe from entering the duct, the instrument must be withdrawn, or its point turned in different directions until the probe enters the duct; but should there be a decided obstruction at this [illegible], the probe may be carefully forced through it, but this is hardly likely to be the case if the blade of the knife has previously passed along the canal. If there is much difficulty in passing the probe into the nasal duct, which may happen in chronic cases, the sac having much diminished in size, it is advisable to slit up the upper as well as the lower canaliculus, so as to leave a large opening into the sac, the internal palpebral ligament being freely divided, and by this means procure a free opening from above for the passage of the instrument down into the sac and duct.

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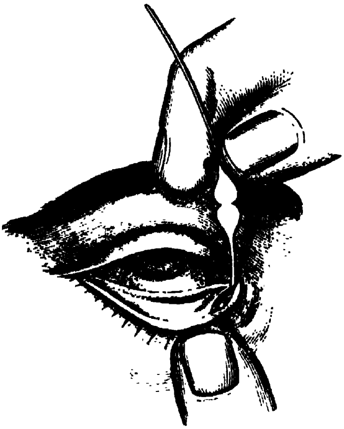
[*] A style is a small piece of silver wire, about one-twentieth of an inch thick, and one and a half inches long, having a neck bent at an obtuse angle with the shaft of the instrument, and terminating in a head.

Fig. 19.



Pierce obstructions.

The size of the probe to be employed will, of course, vary with the nature and extent of the stricture. As soon as the end of the probe touches the mucous membrane of the nose, the patient feels it there, so that there can be no mistake as to the passage of the instrument. I need hardly remark that it is very necessary to handle our instrument lightly, when endeavouring to pass the knife or a probe through a stricture in the nasal canal, otherwise we may run the instrument through the bony wall of the canal, and inflict a permanent injury on the part.

Using great caution.

In the case of stricture of the sac or nasal duct, complicated with a lachrymal fistula, the probe should, if possible, be passed through the nasal duct about twice a week, until it is fully dilated. The natural passage of the tears being thus restored, the fistula will probably heal of itself.

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* Mr. Bowman on Lachrymal Obstruction: *Ophthalmic Hospital Reports*, vol. i. p. 16.

It often happens, however, that all our efforts to restore the natural channel for the tears are ineffectual, and consequently the fistula remains open, to the great annoyance of the patient. To remedy this state of things, three methods of procedure are open to the surgeon—1st, the introduction of a style; 2nd, the obliteration of the lachrymal sac; and 3rd, removal of the lachrymal gland.

1. The style.

How used.

1. I have already spoken of *the style* as having fallen into disuse; but if the surgeon determines to employ it, the following is the method of doing so.* Should the fistula not be in such a position as to enable us to pass a probe through it into the nasal duct, it must be slit up so as to allow of this being done. We may then pass an ordinary lachrymal probe through the duct into the nares. The style may subsequently be introduced, and allowed to remain in the duct for two or three days, when it must be withdrawn, cleansed, and returned into the duct. In the course of time the canal becomes enlarged, and in the interim the tears find their way down into the nose along the sides of the style.

Objections to styles.

The cure, however, is a tedious one; and after all, when the style is permanently removed, the duct is very apt to contract again. But independently of the chances of a relapse, the irritation caused by the style is often so great, that people cannot possibly wear it; and lastly, the instrument frequently slips from its position, and the patient cannot return it into the nasal duct. Consequently, the method of treating a fistula by means of a style is not a promising one, and is certainly surpassed by either of the other proceedings now to be described.

2. Obliteration of the sac.

2. Obliteration of the lachrymal sac, in cases of fistula, has been advocated by Dr. Manfridi,† of Turin.

The lachrymal sac must be laid completely open, and, if necessary, the tendon of the orbicularis cut through to expose the superior end of the sac. Manfridi then introduces a speculum into the wound, and the sac is to be carefully cleansed of blood and matter; after which its entire surface is to be smeared over with chloride of antimony. A piece of dry lint is to be placed in the cavity, over which poultices may be applied, our objects being "the total destruction and extrusion of the sac, without which we cannot hope for a complete and permanent result." After the destruction and enucleation of the sac in this way, "a channel of communication sometimes still exists between the lachrymal conduits and the nasal canal."

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* "Maladies des Yeux," par L. A. Desmarres, tom. i. p. 369.

† *Ophthalmic Review*, vol. ii. p. 418.

By chloride of antimony

Mr. Windsor, of Manchester, prefers, after completely laying open the lachrymal sac, to fill it with dry lint, allowing the lint to remain in the sac for two days. It is then removed, and the walls of the sac having been thoroughly cleansed, the cavity is to be filled with lint soaked in the chloride of zinc paste, which should be allowed to remain in the sac for two hours. The lint may then be removed, and water-dressing applied. The sac sloughs, and comes away in the course of a few days, and the wound rapidly heals.

or chloride of zinc.

3. Lastly, removal of the lachrymal gland, for the cure of a fistula of the lachrymal sac, has been practised by Mr. J. Z. Laurence with success.* (See page 81.)

3. Removal of lachrymal gland.

CHRONIC INFLAMMATION OF THE LACHRYMAL SAC is a common form of disease. It usually commences with subacute inflammation of the lining membrane; but the irritation extending to the mucous membrane of the canaliculus and nasal duct, these passages become swollen and obstructed, and the sac is slightly distended in consequence of the accumulation of mucus within it. Under these circumstances, if pressure be made over the sac, a whitish, glairy fluid may generally be forced through the puncta. The lachrymal secretion cannot pass through its natural channel, and accumulating in the inner corner of the eye, it runs down over the cheek, giving the patient constant annoyance; he seldom complains of pain in the part, but is occasionally troubled with an itching sensation in the region of the sac.

CHRONIC INFLAMMATION OF THE SAC.

Mucus collects in the sac.

Lachrymation.

No pain.

Chronic inflammation of this kind may exist for months, without either increasing or receding; but at any time acute inflammation may supervene, and an abscess of the sac and fistula result.

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* *Ophthalmic Review*, vol. iii. p. 138.

Abscess may form.

Treatment.

Open the sac.

Treatment.—It is advisable, as soon as possible, to open the sac by slitting up the punctum and canaliculus, and to run the knife down through the nasal duct; subsequently the edges of the wound should be kept apart till they have healed, so as to establish a permanent opening into the sac, and a probe will have to be passed, to keep up a free communication into the nares; the patient should make pressure with his finger over the inner corner of the eye three or four times a day, so as to empty the sac. This done, the sac gradually contracts: the mucous membrane takes on a more healthy action, and the disease is cured. The recovery is expedited by syringing out the sac once a day with an astringent lotion (two grains of alum and two of sulphate of zinc to an ounce of water), after having pressed out the contents of the sac; the lotion may be injected with an Anel's syringe. It is advisable to continue this application for some time after all symptoms of the inflammatory action have disappeared.

Keep it empty.

Inject astringent lotions.

MUCOCELE.

MUCOCELE consists in an accumulation in the lachrymal sac of its normal secretion, the nasal duct being almost always occluded, and in the majority of cases there is also more or less obstruction in the canaliculi, a watery eye results, and the sac becoming distended, a small tumour forms at the inner angle of the eye, its size varying from that of a split pea to a pigeon's egg. The patient complains of little or no pain in the part, and the skin over the sac is not inflamed. During the early stages of the disease fluctuation may be felt in the sac, but as it becomes more distended and tense, it feels harder, and might possibly be mistaken for a fibrous growth. The canaliculi and nasal duct being occluded to a greater or less extent, it generally requires firm pressure to be made over the mucocele before its glairy contents can be forced out through the puncta.

Mucus collects in sac.

Forms a firm tumour.

Treatment.

Treatment.—The sac having been opened through the canaliculus, it will then be necessary to dilate the obstruction in the nasal duct as I have already described; for it must be remembered that both the upper and lower openings into the sac are for the most part closed in cases of mucocele. These obstructions having both been overcome, we may hope to restore the passage of the tears into the nose, and thus effectually cure the disease.

Remove the obstructions.

POLYPI AND CONCRETIONS.

Polypi and Concretions in the Sac.—A polypus has been known to grow from the lining membrane of the lachrymal sac. Calcareous concretions also may form in it, obstructing the passage of the tears into the nose. A polypus in this situation is a very rare form of disease; it induces symptoms similar to those of mucocele, but the tumour feels less elastic to the touch, and of course no fluctuation can be felt in it. If there is any doubt on the subject, a grooved needle may be run into the tumour and its character ascertained with certainty.

How distinguished.

The nature of the obstruction, if arising from calcareous matter, may be at once ascertained by passing a probe into the sac; the contact of the instrument with the sandy particles, accumulated either there or in the canaliculus, cannot be mistaken for any other condition of the parts.

Treatment.

By careful removal.

In cases of this kind the canaliculus and sac must be laid open, and the calcareous matter turned out of them. The same remark applies to the treatment of a polypus; but in this case the tissues covering the sac must be divided, and the polypus carefully removed, together with its peduncle, otherwise it will certainly grow again.

OBSTRUCTION OF NASAL DUCT.

Obstruction of the Nasal Duct.—The nasal duct sometimes becomes partially, or it may be wholly obliterated, most commonly from chronic inflammation and thickening of the lining membrane; but it may be from periostitis, or disease of the bones forming the walls of the lachrymal duct.

Swelling of the sac. Lachrymation.

Regurgitation by puncta.

The symptoms caused by obstruction of the duct are, dryness of the corresponding nostril, the formation of a slight, painless, and elastic swelling in the position of the lachrymal sac, and a constant overflow of tears from the eye. By pressure over the region of the sac, we may determine whether the obstruction is in the nasal duct, or between the puncta and the sac; if the latter, there will be no regurgitation of muco-purulent fluid through the puncta; but if the stricture be in the nasal duct, though the symptoms above enumerated exist, the lachrymal secretion will find its way into the sac, and on pressure being made over it, a drop of fluid will ooze through the puncta. If the stricture is not complete, part of it may find its way down into the nose.

Treatment.

The treatment of stricture of the nasal duct has already been described, page 140. It consists of opening the canaliculus and passing a narrow-bladed knife and subsequently a full-sized probe down through the lachrymal sac and the obstructed duct, so as to dilate the passage. The probe should not be passed more than once or twice a week, but the dilatation of the passage frequently requires much patience, on the part of the patient, and the surgeon also.

Dilate the passage.

Should the obstruction be a bony one, which is very rare indeed, compared with the number of cases that occur from thickening of the mucous membrane, we are not likely to cure it with the probe; it might then possibly be necessary to destroy the lachrymal sac, and perhaps to remove the lachrymal gland, though I have never had to perform an operation of the kind for cases of this description.

Destroy the sac.

INFLAMMATION OF THE ANGLE OF THE EYE, simulates abscess of the sac.

INFLAMMATION OF THE INTERNAL ANGLE OF THE EYE.—An abscess in this situation may lead to the erroneous supposition that the sac itself is involved in the mischief. That such cases occur is certain, for we see abscesses form and burst in this situation without the lachrymal apparatus being in any way compromised. In instances of this description, the abscess comes on without any symptoms of previous disease of the lachrymal sac; the inflammation sets in suddenly, and is not uncommonly attended with erysipelas, especially if the patient is in a weak state of health. The eyelids become much swollen, and lachrymation may exist from pressure of the abscess on the lachrymal sac. After a few days suppuration occurs, and the abscess points; a small quantity of pus escapes, and in a short time all traces of the disease disappear.

Often erysipelatous.

Treatment.

Arg. nit.

Treatment.—In the early stages of the disease we may paint the skin over the sac with a strong solution of nitrate of silver. Subsequently, if suppuration has taken place, the abscess must be opened and poultices applied till pus ceases to be formed. The wound heals, and the parts speedily return to their normal condition.

Poultices.

DEFICIENT TEARS.

DEFICIENT SECRETION OF TEARS.—I have already noticed, page 80, some of the diseases to which the lachrymal gland is liable; but we occasionally meet with cases in which, without any apparent cause, the gland ceases to secrete. I had a lady under my care same time ago, who never knew what it was to shed a tear; she was unable to cry because the lachrymal gland never secreted any tears. In this case the patient did not suffer from dryness of the eye or other inconvenience, as is sometimes the case in affections of this kind. We can hardly expect to be able to rouse the lachrymal gland to action under these circumstances, but we may be able to relieve the symptoms of dryness of the eye to which it occasionally gives rise, by applying a dilute sol[illegible] of potash to the conjunctiva three or four times [illegible] few drops of liquor potassæ to an ounce of water will be about the strength required.

Eye may or may not be dry.

Potash lotion for.

EPIPHORA is just the opposite condition to the above; the tears are secreted in such large quantities that they cannot find their way down through the puncta, and collecting in the corner of the eye, they overflow and run down the cheek. There is no fault whatever with the lachrymal passages, but simply an excess of tears formed by the gland.

EPIPHORA.

Excess of tear

Temporary epiphora, for instance, is induced by the presence of a foreign body on the surface of the cornea, or it arises from irritation in some other part of the body—as, for instance, from intestinal worms, or from teething. As a general rule, it is to these exciting causes we must direct our attention; by removing them the lachrymal gland will resume its normal functions, whereas the application of blisters to the temple, and all local remedies, will be perfectly futile.

If temporary, remove cause.

In cases of a more permanent kind, where our endeavours have failed to afford relief, we are justified in excising the lachrymal gland. The watery eye, on the one hand, is a constant source of trouble to the patient, and on the other, the removal of the gland is attended with no further inconvenience than that caused by the necessary incisions. These will probably heal in a week or ten days, and leave the patient quite unconscious of his loss, except under circumstances of emotional disturbance; and this deficiency of tears is more than compensated by the prevention of their overflow. Nor will the eye be left absolutely dry, for

If permanent, remove gland.

although the lachrymal gland is removed, a considerable quantity of watery fluid is still secreted by the subconjunctival glands, which keeps the mucous membrane moist, independently of the secretion from the lachrymal gland.

LACHRYMAL CYSTS.

Appearance.

LACHRYMAL CYSTS (Dacryops) commence as small tumours in the upper and outer part of the eyelid, extending backwards, beneath the border of the orbit, towards the lachrymal gland. "If the lid be drawn up on to the brow, and pressure be simultaneously applied in a downward and inward direction, a tense, elastic, fluctuating swelling instantly starts out between the eyeball and the inner surface of the eyelid."* As the tumour increases in size, the movements of the eye become restricted, and it may even cause exophthalmos. If the patient cries, the tumour suddenly enlarges; this is a very characteristic feature of the affection.

Impede the eye.

Arise from obstructed ducts.

This rare form of disease, as Mr. Hulke states, depends for the most part upon obstruction of one or more of the lachrymal ducts, in consequence of a neglected abscess or wound of the eyelid. The tears, being prevented from escaping, collect behind the point of stricture and cause the dilatation of the duct above described.

To be opened from within.

Treatment.—A permanent opening must be made into the cyst from the inner surface of the eyelid, the tears can then pass away over the eye. If the opening is made externally through the skin of the eyelid, a very troublesome fistula may result.

FISTULÆ.

FISTULÆ OF THE LACHRYMAL GLAND occasionally form as the result of an abscess or injury of the gland. A fistulous opening leading to the lachrymal gland having formed, it may be in the skin of the upper eyelid, a clear fluid discharge constantly drains away through it over the skin of the lid, and a probe may be passed through the fistula in the direction of the lachrymal gland. In a case of this kind it is advisable to pass a probe along the course of the fistula, and then, having everted the eyelid, to cut down

Open from within.

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* Mr. J. W. Hulke on Dacryops Fistulosus: *Oph. Hosp. Reports*, vol. i. p. 285.

through the conjunctiva on to the probe, and in this way create another fistulous opening on the palpebral conjunctiva, so as to conduct the lachrymal secretion to its proper destination. The actual cautery should then be applied to the mouth of the fistulous opening on the outer surface of the eyelid, in the hope that the inflammatory action thus excited may, on the separation of the little slough caused by the cautery, close the external fistula. All other means of treatment having failed, it may be necessary to excise the lachrymal gland in order to cure the fistula.

Cauterize the mouth.

CHAPTER VI.

DISEASES OF THE SCLEROTIC.

Hyperæmia—Episcleritis—Ulceration—Sclero-choroiditis anterior—Wounds and Injuries—Tumours.

HYPERÆMIA.

HYPERÆMIA OF THE SCLEROTIC.—When describing the anatomy of the eye, p. 2, I mentioned that the conjunctiva is supplied with a superficial and deep set of vessels, and that these form a ring of anastomosis round the circumference of the cornea, from which vessels are given off, which perforate the sclerotic and anastomose with those of the iris and choroid. This latter set of vessels is known as the "sclerotic zone of vessels," or "the arthritic ring;"* and which is situated in the subconjunctival tissue; it is frequently made apparent by congestion, when the circulation in the internal structures of the eye is deranged; it becomes a most valuable indication of the vascular condition of the intra-ocular parts. (See Fig. 2, Plate III.) Unless, however, in diseases of the cornea, iris, or choroid, the congested "sclerotic zone" is seldom or never seen: if, therefore, we are to consider the appearance of the "arthritic ring" as an indication of hyperæmia of the sclerotic, we must admit that the latter pathological condition is but rarely observed in practice, except as a complication of alterations in the neighbouring structures.

The "Sclerotic zone."

Denotes intra-ocular disease.

The importance of this fact can hardly be too strongly insisted on. From a large observation of cases, I can safely say I know of no symptom in diseases of the eye more commonly overlooked or misunderstood than that of the sclerotic zone of vessels. Cases are constantly sent to me as suffering from sclerotitis, or keratitis, whereas the real seat of the disease is either in the iris or choroid.

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* The term, "arthritic ring," has been applied by some pathologists to a narrow white ring sometimes seen between the cornea and the vascular zone, and which was formerly supposed to be characteristic of rheumatic or "arthritic" inflammation. This is, however, not the case, nor has the appearance any diagnostic value.

Often misunderstood.

In all doubtful cases of the kind it is extremely desirable to apply atropine to the eye, and watch its action on the pupil, which will frequently be found to dilate irregularly, from the presence of synechia, the result of iritis, and if so, all difficulty in the diagnosis will be cleared up. The atropine can do no harm, even supposing the condition to arise from some other affection of the eye, and as a test of the participation of the iris and choroid in the disease, it is invaluable, especially to those who are not in the constant habit of examining patients suffering from diseases of the eye.

Atropine a test of iritis.

EPISCLERITIS.—We occasionally meet with cases, especially among adult females, in which *parenchymatous formations* of a limited character take their rise in the sclerotic. A patient affected in this way presents himself to us with a dusky-red or reddish-yellow elevated spot in the sclerotic, probably as large as a split pea or bean, usually situated on the inner or outer side of the globe, near the insertion of the recti muscles. There is generally some slight conjunctivitis over and around this little nodule in the sclerotic. The patient seldom complains of pain or inconvenience beyond a slight stiffness in the movements of the eyeball; nevertheless, in some cases, especially those subject to rheumatism, the patient complains of intense neuralgic pains extending from the affected eye over the side of the temple, with considerable photophobia. The protuberance feels hard, precisely as if a small fibrous tumour were growing from the sclerotic; the part is vascular, but the rest of the eye may be perfectly healthy.

EPISCLERITIS.

Raised and red spot on sclerotic.

No pain.

Some of these cases may be traced to a syphilitic taint, the hypergenetic process in the sclerotic resulting in the formation of a gummy tumour of small size, pursuing the same course as similar growths do in other parts of the body, and under these circumstances the growth in the sclerotic is likely to recur after it has disappeared for a time.

"Gummy" character.

Progress slow.

The progress of episcleritis is very slow, often lasting for several months; but it has a natural tendency to recovery, and will in time disappear, unless stimulated to increased growth by the injudicious application of caustics and similar agents to its surface.

Treatment.

Iodide of mercury.

No local application.

Treatment.—The eye should be kept at rest with a pad and bandage, and, as a general rule, iodide and bromide of potassium combined with bichloride of mercury, and a generous dietary, will hasten the removal of these parenchymatous growths. Local applications are not often required, but Mr. Soelberg Wells thinks that a solution of chloride of zinc, ¼ of a grain to an ounce of water, gradually increased to gr. ij to the ℥j, is useful; and I have no doubt that a solution of atropine (gr. ij to the ℥j) dropped into the eye once or twice a day is beneficial, especially in cases attended with neuralgic pain over the temple and in the affected eye.

ULCERATION OF SCLEROTIC.

ULCERATION OF THE SCLEROTIC.—Mr. Bowman has described a peculiar form of this affection as "small, intractable ulcers of the sclerotic,"* and I have lately met with a case of this kind. The patient was in bad health, the ulcers occurred in succession in both eyes, and were situated near the cornea; they looked as though a small piece of the sclerotic had been punched out; and in the right eye they extended so deeply into the sclerotic, that ultimately it was perforated. The disease was of a most obstinate nature, and the patient suffered considerably from pain in the eyes, intolerance of light, and profuse lachrymation.

SCLERO-CHOROIDITIS.

SCLERO-CHOROIDITIS ANTERIOR.—By this term is understood an affection of a limited portion of the choroid and sclerotic tunics, which may or may not be inflammatory in its origin, but which results in the adhesion, wasting, discoloration, and ultimate bulging of the parts from intra-ocular pressure. Sclero-choroiditis anterior is said to be "partial," when only a portion of the sclerotic between the cornea and equator of the eye is involved; it is "complete" when the whole circumference of the globe is involved, the diseased action being in by far the majority of cases con-

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* Bowman, "Parts concerned in Operations on the Eye," Appendix, p. 109.

Thinning and bulging of sclerotic.

fined to the region of the ciliary body and processes. In the complete form of the disease, the sclerotic is extensively degenerated, and at the same time the intra-ocular pressure is increased, so that the anterior part of the globe is forced forwards, the diseased sclerotic yielding before the increasing tension of the globe; the front of the eye thus becomes forced more or less from the orbit, projecting, it may be, so far forwards as to interfere with the closure of the eyelids. Some greatly dilated ciliary vessels appear on the surface of the projecting sclerotic, or *Staphyloma* as it is called.

"Staphyloma."

Causes and varieties.

Sclero-choroiditis anterior may arise:—1st, From primary degenerative changes, involving the vessels and fibrous tissue of the parts, including the sclerotic; 2nd, From inflammation of the ciliary body, a portion of its structure being destroyed. In this case the sclerotic in the immediate vicinity not only suffers directly from the effects of inflammation, but also from a diminished supply of nutriment and secondary degeneration, in consequence of the disease of the ciliary body; fatty degeneration occurs, it gradually yields to the intra-ocular pressure, and a staphyloma results. 3rd, Sclero-choroiditis may arise from the effects of an incised wound over the region of the ciliary body.

1. Degenerative.

1. In the first class of cases there are no prominent symptoms to mark the advent or progress of the disease;* the structural changes are gradually established, probably commencing with disease of the choroidal vessels of the part, upon which fatty degeneration of the dependent tissues supervenes. These become disintegrated and removed, with the exception of the pigment cells, which seem to resist these changes, and are left isolated and adherent to the sclerotic.

Vascular atrophy.

Gradual wasting of sclerotic.

I before mentioned that the sclerotic is mainly dependent upon the vessels of the choroid for its nourishment; as, therefore, these changes progress in the ciliary body, the sclerotic covering the part ceases to obtain sufficient nutrient material to maintain it in a healthy state; fatty degeneration occurs, and the diseased portion of the sclerotic, being no longer able to

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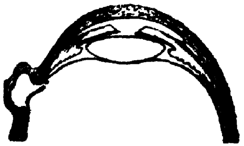
* "Maladies des Yeux," par M. Wecker, vol. i. p. 246.

Staphyloma formed.

resist the intra-ocular pressure, gradually yields to it, and bulging outwards, forms a protuberance over the region of the ciliary body (Fig. 20). The size of the tumour of course depends upon the extent of the degenerative changes that have taken place.

Fig. 20.



Dark grape-like protuberance.

A staphyloma of the sclerotic thus formed is of a dark bluish colour, often almost black, on account of the pigment cells of the ciliary body having become intimately attached to its inner surface, and their colour being seen through the attenuated sclerotic. This form of disease often makes but very slow progress, and may become stationary at any period of the patient's life; but if irritation and congestion are excited in the neighbouring structures, the parts already prone to disease undergo further changes, and a considerable portion of the ciliary body, and of the sclerotic covering it, may become involved in the morbid action. In this case the nutrition of the vitreous and lens is apt to suffer, the former becoming fluid and flocculent, the latter more or less opaque, so as greatly to interfere with the perfection of vision. Under more favourable circumstances, these cases, of what may be called degenerative sclero-choroiditis anterior, do not materially damage the patient's sight.

Progress slow or arrested.

Vitreous and lens degenerate.

2. Inflammatory.

Begins as irido-choroiditis.

Secondary degeneration of sclerotic.

2. In instances of sclero-choroiditis anterior, originating in inflammation of the ciliary body, precisely the same pathological changes ultimately ensue, and result, as in the previous variety, in the formation of a staphyloma. The early symptoms, however, are those of irido-choroiditis; the congested sclerotic zone of vessels exists, indicating abnormalities in the intra-ocular circulation; there is pain in the eye, increased on pressure over the inflamed ciliary body, and intolerance of light; haziness of vision from opacity of the vitreous follows; and there is marked increase of tension of the eyeball. The symptoms often run a subacute course; but from effusion taking place into the part, the choroid is apt to be torn away from the sclerotic; or from damage done to its vessels during the inflammation, degenerative changes often progress rapidly in the latter structure, and as I have above

described, in cases not originating in inflammation, it gradually yields to the intra-ocular pressure, and a staphyloma occurs. This bulging of the sclerotic may be of very considerable size, so much so as ultimately to project forwards between the eyelids and impede their movements, or even prevent their closing. In instances of this kind the retina becomes detached, and the eye totally destroyed. On the other hand, if the staphyloma does not reach any very considerable size, and a sufficient quantity of healthy choroid is left to supply nourishment to the vitreous and lens, the patient may retain a very fair amount of vision for a time; but in too many cases of this description exacerbations of the disease occur, ending in destruction of the eye.

Staphyloma.

Sight may be lost.

3. In instances of wounds dividing the sclerotic over the ciliary region, a hernia of a portion of the ciliary body may take place through the incision, and unless the case is speedily brought under treatment, the intra-ocular pressure not only forces the edges of the wound apart, but protrudes more of the ciliary process through it. This extruded portion becomes, in the course of time, covered by fibrous tissue, so that a staphyloma is formed, the inner surface of which is lined by the remains of the ciliary body or choroid, according to the position of the original wound. In consequence of the irritation and stretching to which the parts are exposed, subacute inflammation is established, and progressive degenerative changes, such as I have already described in other cases, set in; more of the sclerotic may, in this way, be involved, until at last a very large staphyloma is formed.

3. Traumatic.

Ciliary hernia.

Adventitious coating.

Resulting staphyloma.

In instances of this description, unfortunately, the damage is not confined to one eye—the irritation is too frequently propagated from the injured eye to the sound one, and unless the source of irritation is removed, the patient will very probably lose his sight altogether.

Implication of the other eye.

From whatever cause a staphyloma of the sclerotic may arise, it follows, if the protrusion be a large one, surrounding perhaps the whole or a greater part of the circumference of the eye, that extensive changes must occur within the globe. Hence we notice in cases of this kind that the iris becomes altered in colour, the lens often opaque and more or less dislocated, the

Deep-seated changes.

vitreous watery, and the depth of the anterior chamber is greatly increased. In fact the eye thus affected becomes almost completely disorganized.

Treatment.

Treatment.—In the degenerative form of sclero-choroiditis anterior, but little can be done to cure the essential disease, which often depends upon a scrofulous or lymphatic diathesis. Much may be effected, however, in the way of preserving the eye from further damage, by warning the patient of the danger he runs from over-exerting it, and of the necessity there is for protecting it from external injury and from the glare of the sun, and, in fact, of taking all possible care of the diseased organ. In this way the structural changes may be prevented from making further progress, especially if at the same time the patient's general health and nutrition can be improved by a change of circumstances and appropriate regimen. Any depressing influences are likely to tell upon the weak point, and as surely the sclero-choroiditis will then advance steadily onwards.

Rest and protect the eye.

Improve the general health.

Subdue inflammation.

If the affection depends upon inflammatory changes, our treatment must be mainly directed towards the mitigation of the primary cause of the disease; and as a means to this end we shall probably resort, among other measures, to paracentesis or iridectomy; but for further details on this subject, I would refer to the chapter on irido-choroiditis. When once a staphyloma has formed, the eye will require every care and attention, on the part of both surgeon and patient, in order to prevent a recurrence of the inflammatory action and an increase of the staphyloma. If, in instances of this description, the staphyloma is of considerable size, and the sight of the eye destroyed, there can be no two opinions as to the propriety of excising the anterior part at least of the diseased eyeball (abscission). If this is not done, the irritation going on in the part may very probably lead to sympathetic irritation in the other eye, while its removal will save the patient much annoyance and inconvenience.

Abscission; when expedient.

If traumatic, remove protrusion.

In the third class of cases, if the wound of the sclerotic is of recent origin, and a portion of the ciliary body is protruding through the wound, it is advisable to put the patient under the influence of chloroform, and a Weiss's stop-speculum having been adjusted, the extruded choroid is to be snipped off, and the sclerotic edges of the wound carefully brought together, and retained in apposition with a fine suture. The eyelids should subsequently be closed, and the eye kept at rest with a pad and bandage. We may possibly in this way prevent the formation of a staphyloma, and the sclero-choroiditis attending it.

Close by sutures.

If the case, when first brought to our notice, be of long standing, it will be well not to interfere, provided the staphyloma is of no great size, and the patient retains some amount of sight. But if the vision is destroyed, and the staphyloma is a large one, the sooner abscission of the eyeball is performed the better.

Except in old cases.

Another consideration must also guide our practice in such cases. Sympathetic irido-choroiditis, as I have elsewhere explained, is a most insidious and dangerous form of disease, and is what we have most reason to fear in cases of sclero-choroiditis arising from wounds of the sclerotic. I have no hesitation, therefore, in saying, that supposing the sight of the injured eye is partially retained, but the vision of the sound eye gradually becomes impaired, or symptoms of irritation in the cornea or deeper structures make their appearance, extirpation or abscission of the injured organ must be insisted on at once; any delay, under these circumstances, may end in total loss of sight in both eyes. On the other hand, by removing the diseased eye in time, we may reasonably hope to stop the further progress of the malady in the sound one, the effects of which we shall never be able to cure if allowed to run its course.

Sympathetic irido-choroiditis.

Endangers sight.

Necessitates immediate extirpation.

WOUNDS OF THE SCLEROTIC.—Incised wounds of the sclerotic are by no means of common occurrence, the part being so well protected by the bony walls of the orbit. When an injury of the kind does occur, we seldom see a hernia of the choroid (as in the case of the ciliary body) on account of the intimate nature of the connexion that exists between the choroid and the sclerotic. The retina, however, under these circumstances, is generally torn through, and a portion of the vitreous escapes; the torn edges of the retina are apt to get entangled in the wound, and as the latter cicatrizes and contracts, the retina is dragged from its attachments to the choroid, and the patient's sight is destroyed.

WOUNDS OF SCLEROTIC.

Retina involved in the cicatrix,

And displaced.

I lately saw an instance of the kind in a lad who

Case,

had been struck by a piece of percussion-cap on the outer part of the eye; the sclerotic had been torn open, and the wound had subsequently cicatrized. At the time I saw this boy, some few months after the accident, the eye appeared healthy; but on dilating the pupil with atropine, I found that the retina stretched across the posterior concavity of the eye, like a curtain in the vitreous chamber, having been drawn into that situation in the way I have described. The sight of the eye was of course completely destroyed.

As I have mentioned in the preceding page, we should if possible bring the edges of an incised wound in the sclerotic together with fine sutures as soon as possible after the injury, especially if the wound is not a large one, and no very considerable portion of the contents of the globe have escaped.

RUPTURE OF SCLEROTIC.

RUPTURE OF THE SCLEROTIC.—This accident may occur from a direct blow on the eye, inflicted with a blunt instrument, or the closed fist, or from a fall. In cases of this description, the sclerotic is most commonly burst open at its upper or inner part, near the margin of the cornea, or between the cornea and the insertion of the recti muscles.

Escape of lens, and vitreous.

Retina detached.

Hæmorrhage.

A blow on the eye, sufficiently severe to rupture the sclerotic, necessarily affects the other structures contained in the eyeball, and at the instant when the sclerotic bursts open, the lens is usually forced out through the wound, dragging the iris, and often a portion of the choroid, away with it. The vitreous may also escape, and, in fact, the eye too often collapses, and is totally lost.* In less severe cases the retina may be detached from the effects of the concussion, or from the bursting of some of the choroidal vessels, and the hæmorrhage which then takes place behind it. Under these circumstances, the anterior and vitreous chambers may become filled with blood, and it will be impossible to ascertain exactly the lesions that have taken place in the fundus of the eye until the blood has become absorbed.

CONTUSIONS.

SIMPLE CONTUSIONS of the sclerotic, apparently of a trivial nature, are at times followed by remarkable changes in the vitreous. Probably, the circumstance of the injury is forgotten, and the patient consults the practitioner for gradual loss of sight, usually complaining also of dark objects waving about before the field of vision. On examining the eye with the ophthalmoscope, we shall find that the vitreous is fluid, and small brown or black specks may be seen floating about in it. It is evident that in these cases the vitreous body has gradually lost its consistency, in consequence of some impairment in its nutrition, determined by the blow; and the retina, having lost its normal support, is in danger of becoming detached, and the patient's sight destroyed.

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* See several cases reported by Mr. Hulke: *Ophthalmic Hospital Reports*, vol. i. p. 292.

Vitreous may become fluid,

And retina detached.

Prognosis unfavourable.

Prognosis.—The prognosis to be formed in instances of severe wounds or injuries of the sclerotic, is, as a general rule, very unsatisfactory. Even in slight cases, complications such as I have above indicated, consisting of detachment of the retina, or degeneration of the vitreous, may occur, and damage the sight. Lastly, injuries of this description are likely to involve the choroid, entailing remote ill consequences, as I shall subsequently explain when speaking of diseases of that structure.

Treatment.

Sutures in rupture.

Treatment.—In a case of rupture, if no great amount of the vitreous has escaped from the wound, its edges must be brought together by means of fine sutures, and the eye kept at rest till the wound has healed. But if the lens and a considerable portion of the vitreous have escaped through the opening in the sclerotic, it will be well to allow the globe to collapse, the eye being, of course, irrecoverably lost. Unfortunately the mischief does not stop here, for sympathetic irritation is not uncommonly set up in the other eye, requiring the removal of the injured organ. It will always be a matter for consideration, therefore, if it may not be as well to excise the globe as soon after the accident as possible; and I think that among the lower classes this step will generally be advisable, supposing, of course, that the eye has collapsed and been lost. Any attempt to preserve the stump of the eye, as a support for an artificial one, will be useless among the poor, for these people would find an ornament of this description more trouble than it was worth. Among the upper classes, on the contrary, where time is less important, and ornamentation a thing to be considered, we may allow of some delay before removing the remains of the injured eye;

Excision when expedient.

Among the poor

and wealthy.

and if no symptoms of sympathetic irritation arise in the other, the collapsed globe will form an admirable support on which to rest an artificial eye.

TUMOURS.

TUMOURS OF THE SCLEROTIC.—Morbid growths, whether cancerous or otherwise, rarely commence in the sclerotic, though doubtless this structure is frequently involved in tumours springing from the choroid within, or from the tissues contained in the orbit without. Mackenzie mentions several cases of sarcomatous tumours growing from the sclerotic; he says they most commonly occur amongst scrofulous subjects. The tumours are sometimes single, sometimes in clusters; they may be soft or hard, vascular or non-vascular. The tendency of these morbid growths is to disappear by progressive ulceration; but the morbid process is apt to result in perforation of the sclerotic, and the eye then becomes atrophied and destroyed.

Fibro-plastic,

In scrofulous subjects.

Tendency to ulceration.

Mackenzie says these fibro-plastic tumours present themselves most frequently on the temporal side of the eyeball, and at first are of a whitish colour. Their disposition is to spread and involve the parts around them as they ulcerate.*

Melanotic.

A few rare cases are on record in which melanosis has attacked the sclerotic, springing from its external surface, and not involving, at least for some time, the other structures contained within the orbit.†

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* Mackenzie "On Diseases of the Eye," 4th edit. p. 703.

† Mr. Poland on Protrusion of the Eyeball: *Ophthalmic Hospital Reports*, vol. i. p. 171, where two such cases are referred to.

CHAPTER VII.

DISEASES OF THE CONJUNCTIVA.

Hyperæmic—Muco-purulent—Purulent—Diphtheritic—Granular—Pustular Conjunctivitis—Injuries of the conjunctiva—Hypertrophy and Atrophy—Pterygium—Relaxation—Serous and bloody effusions into the conjunctiva—Tumours of the conjunctiva—Diseases of the caruncle.

CONJUNCTIVITIS.

CONJUNCTIVITIS. WE may now proceed to study the diseases of the conjunctiva, and as they will constitute the larger portion of the "eye cases" we shall meet with in practice, they demand a careful consideration. **Classification.** I propose describing the various forms of conjunctivitis (ophthalmia) under the following heads:—Hyperæmia, Muco-purulent, Purulent, Diphtheritic, Granular, and Pustular Conjunctivitis.*

Transitional forms. It is difficult, in the first three of these affections, to draw a line of demarcation between the commencement of one form of disease and the termination of that preceding it; thus, muco-purulent conjunctivitis is always preceded by hyperæmia, and purulent conjunctivitis by both hyperæmia, and muco-purulent conjunctivitis; yet, practically, the distinction will be found both natural and useful. The symptoms of diphtheritic, granular, and pustular conjunctivitis are sufficiently well marked to distinguish them from one another, and also from the first named affections of the conjunctiva.

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* It seems to me hardly wise to retain the word *ophthalmia* to designate diseases of the conjunctiva; we employ the terms iritis, choroiditis, and so on, to signify inflammation of the iris and choroid; why not, therefore, conjunctivitis in analogous diseases of the conjunctiva?

Purulent discharge contagious.

The discharge from the eye of a patient suffering from purulent conjunctivitis will, in the great majority of cases, if inoculated into the healthy conjunctiva, induce a like form of disease; still, this sequence is not so invariable as is generally supposed; for instance, the pus from the eye of a patient affected with purulent conjunctivitis may excite the diphtheritic form of disease, if introduced into the eye of a person already predisposed to diphtheria.* It is consequently impossible to predict, with absolute certainty, the form of conjunctivitis from which a patient may suffer, although exposed to a specific contagion; and it behoves us, therefore, to watch the invasion of the disease in each instance; for upon an accurate diagnosis, and a well-selected plan of treatment at this stage, the issue of the case often depends, and the remedies to be employed in one set of cases are often absolutely injurious in another, as, for example, in purulent and diphtheritic conjunctivitis.

"Healthy" pus innocuous.

I need hardly remark, that "healthy pus" as it is called, that, for instance, which is generated during the repair of a wound, or from a simple abscess, although the conjunctiva be carefully inoculated with it, cannot excite inflammation. The nature of healthy pus, as distinguished from that which is capable of propagating disease by contagion, is one of the many pathological problems yet to be solved; but the spread of the various forms of conjunctivitis by this means, is an established fact, and the contagious nature of all forms of conjunctivitis, attended with a purulent discharge, should lead us to separate the affected from the healthy portion of the community.

Egyptian ophthalmia.

A remarkable instance of the melancholy results which follow a neglect of this rule, is to be found in the case of the purulent form of the disease, which is seen in Egypt at the present day; this affection of the eye being there endemic, and propagated from one individual to another, and from generation to generation.

Glare of sun not the essential cause.

It is commonly asserted that the glare of the sun, and the presence of numerous particles of sand in the atmosphere, are concomitant, if not the principal causes of the disease among the lower classes in Egypt; but this theory can hardly hold good, for in parts of India the people are subject to the same influences, and yet they do not suffer like the Egyptians from purulent conjunctivitis.

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* "Maladies des Yeux," par M. Wecker, vol. i. p. 32.

Diphtheritic conjunctivitis.

With regard to the diphtheritic form of the disease, it is rare to meet with a case among the natives of India, or in fact among the inhabitants of any part of the world, except those of Belgium and certain parts of Germany.

Granular conjunctivitis.

As to the much disputed question of the pathology of granular conjunctivitis, I may here remark that the disease consists essentially in neoplastic formations, and arises from the proliferation of the connective-tissue corpuscles of the conjunctiva; and that the swollen and hypertrophied state of the villi of the mucous membrane, generally met with, but by no means characteristic of this form of disease, is an incidental and comparatively unimportant feature. The enlarged papillæ are to be carefully distinguished from the neoplastic growths, which induce the phenomena characteristic of granular conjunctivitis. No doubt the word "granular" has given rise to a confusion of ideas; for, in the first place, mere hypertrophy of the papillary tissue, which is common to various forms of conjunctivitis, occasions *a granular appearance;* and secondly, the term is suggestive of "granulations;" but, as I shall subsequently explain, the neoplastic growths of granular conjunctivitis are more nearly allied to tubercle than to granulations.

Other forms.

I shall give no special description of the purulent conjunctivitis of infants, or of gonorrhœal conjunctivitis; these may well be included under the general head of purulent conjunctivitis; and it seems to me simply complicating a rather difficult subject, to split it up into unnecessary subdivisions. And so again with regard to the exanthematous forms of the disease—those, namely, which are often met with during the progress of measles, scarlatina, or small-pox—they are to be treated upon exactly the same principles as ordinary hyperæmia, or muco-purulent conjunctivitis. The so-called *catarrhal* conjunctivitis, in its milder forms, is described under the heading of hyperæmia of the conjunctiva; in more severe cases the disease assumes the characters of muco-purulent conjunctivitis.

Hyperæmia.

HYPERÆMIA OF THE CONJUNCTIVA, simple conjunctivitis, may be recognised by the following appearances of the parts, and by the symptoms to which they give rise.

Appearance of the parts.

Meibomian glands hidden.

I have already described the healthy orbital conjunctiva as a transparent tissue, through which the white and glistening sclerotic may be seen; on everting either the upper or lower lid, a number of small reddish streaks may be traced beneath the conjunctiva, extending perpendicularly backwards from the margin of the lids; they mark the position of the Meibomian glands, and as they are situated beneath the mucous membrane, it follows that if the conjunctiva is congested, these reddish streaks will be more or less concealed.

Palpebral part red and rough.

Villi turgid, glands large.

In hyperæmia we shall notice, on everting the lids, that the palpebral conjunctiva is not only injected, but that its surface is no longer smooth. (Fig. 1, Plate II.) This arises from two causes,—first, that its villi become prominent from the turgid state of the vessels which they contain; and secondly, its glands are thrown into increased activity, and become enlarged; these, together with the swollen villi, give the mucous membrane a rough appearance, particularly on the tarso-orbital fold, which is also somewhat swollen from the serous effusion poured out into its loose cellular tissue. The eyelids, caruncle, and semilunar folds are also somewhat swollen. The orbital conjunctiva is only slightly affected in simple hyperæmia; it may be that its superficial vessels are congested, in which case they are seen coursing over the sclerotic in a reticulate manner towards the cornea.

As people advance in life, their conjunctivas become somewhat hyperæmic, nor is this condition, under the circumstances, to be considered in itself as an indication of disease.

Conjunctival and scleral hyperæmia distinguished.

Diagnosis.—The student should make himself familiar with the distinctive features of hyperæmia of the conjunctiva, as compared with that of the subconjunctival tissue—a distinction which is of considerable importance; because, while the former indicates a comparatively superficial congestion, the presence of the latter is a sign that the deeper textures of the eye are more or less involved.

Congestion of the orbital conjunctiva can hardly be mistaken for that of the subconjunctival tissue, if the following points be kept in view:—In the former, the enlarged vessels may be readily made to glide over the surface of the sclerotic by gently pressing upon, and moving the mucous membrane under the point of the finger; the vessels of the congested conjunctiva again are most marked towards its palpebral fold, and generally decrease in number and size as they approach the cornea; the larger vessels, moreover, are separate and distinct from one another, and are of a bright scarlet or vermilion colour. On the other hand, hyperæmia of the subconjunctival tissue is always most marked immediately around the margin of the cornea, the vessels being of so minute a size, that they cannot be distinguished from one another; the part appears as though it had been stained of a delicate violet or pink, the intensity of the colour decreasing about two lines from the margin of the cornea, and being gradually lost in the normal whiteness of the sclerotic (compare Fig. 1, Plate II. and Fig. 2, Plate III.). We do not often meet with cases of hyperæmia of the subconjunctival tissue without the conjunctiva being also somewhat congested, so that in the majority of instances the contrast between the two is sufficiently marked to attract the attention of even a casual observer.

Diagnosis.

Subjective Symptoms.—The amount of uneasiness, or even pain to which hyperæmia of the conjunctiva gives rise, depends very much upon the idiosyncrasy of the patient. Some people feel pain much more acutely than others; but the most sensitive individual, suffering from simple hyperæmia, seldom complains of anything beyond a sensation as if sand or grit had fallen into the eye, which is caused by the constant rubbing of the congested vessels of the mucous membrane against the surface of the cornea. This symptom is apt to vary with the age of the patient, being less marked in old persons than in the young, on account of the muscular fibres of the orbicularis losing their contractile power, and pressing the lids less firmly against the eyeball in the case of elderly people. The adipose tissue also, contained in the cavity of the orbit, is gradually absorbed as we advance in life, and the eyeball sinks into its socket, and thus recedes to some

Pain not great.

Sensation of grit.

Less in the aged.

extent from the lids, which then hang loosely over it. Under these circumstances, considerable hyperæmia of the conjunctiva may exist, without the patient feeling any inconvenience whatever from it, because the lax state of the parts admits of considerable vascular engorgement, without any equivalent increase of the mutual pressure between the lids and the globe. These circumstances must be taken into consideration, when judging of the sensations experienced by those suffering from the milder forms of conjunctivitis.

Bright light distressing.

In cases of hyperæmia, if the patient is exposed to the glare of the sun or lamplight, it causes a feeling of weariness and irritation in the eye; this symptom is augmented if the eyes are used for any length of time, so that the patient is often prevented from pursuing his usual calling for more than a few hours together.

Secretions increased.

The secretions from the lachrymal and conjunctival glands are increased in quantity, but are not altered in character; the disease is consequently non-contagious, but the patient complains of his eyes watering a good deal. This symptom, like the last mentioned, is increased by overwork, or exposure to a bright light; it is due to irritation of the conjunctival and lachrymal glands; added to this, the slightly swollen and congested state of the mucous membrane of the lids extends to the lining membrane of the puncta and canaliculi, and the natural passage of the tears into the nose being plugged up, they collect in the inner corner of the eye, and overflowing, induce the lachrymation complained of. On the other hand, in many cases of hyperæmia of the conjunctiva, the diseased action extends in the opposite direction—irritation of the mucous membrane of the nares, spreading through the lachrymal passages to the eyelids—as frequently happens in a common cold, the so-called catarrhal ophthalmia being often thus induced.

Puncta closed.

Lachrymation.

Causes.

Glare.

The Causes of Hyperæmia of the Conjunctiva are numerous: in the tropics the glare of the sun to which people are exposed for nine months out of the twelve, combined with the state of the atmosphere, which is often loaded with dust out-of-doors, and within, among the lower order of natives, with the smoke from the wood-fires, over which they cook their food, together with miasmatic influences, the fumes of ammoniacal

Smoke.

Exhalations.

gases, exhalations from open cesspools, and all manner of putrescent filth—all these are constant sources of irritation and hyperæmia. In colder climates no more common cause for simple conjunctivitis exists than sudden changes in the temperature of the atmosphere inducing a "cold" and ophthalmia.

Foreign bodies.

The presence of a foreign body on the conjunctiva may also give rise to congestion of the mucous membrane. Under this head we should place those cases in which an inverted eyelash, by brushing against the eye, keeps up persistent irritation and hyperæmia.

Disease of retina.

Hyper-metropia.

Disease of the retina may, by reflex action, cause congestion of the conjunctiva; and among hypermetropics, the accommodating power of the eye is overstrained, in order that the necessary convexity of the anterior surface of the lens may be maintained, and hyperæmia of the conjunctiva is the result.

Disordered digestion and secretion.

Lastly, congestion of this membrane may arise from a faulty state of the digestive and secreting organs; thus the dyspeptic and gouty, those that suffer from portal congestion and disorder of the kidneys, from suppressed catamenia and other similar conditions, are very prone to attacks of conjunctival hyperæmia, and the moist and blood-shot eyes of the gluttonous and intemperate are but too familiar.

Treatment.

Remove cause.

Protect the eye.

The Treatment of this affection should, as far as practicable, be directed towards the removal of the cause of the disease; for instance, the eye may be protected from the glare of the sun, or from dust, by neutral tint, or blue glasses. This is a very simple means of relieving hyperæmia arising from over-exposure, but it is unfortunately beyond the resources of the poorer classes, and quite incompatible with their occupation.

Astringent lotions.

Directions for use.

Astringent lotions, composed of one to two grains of sulphate of zinc to an ounce of water, are very beneficial in hyperæmia. Acetate of lead (one grain to the ounce) is probably preferable to the sulphate of zinc. Direct the patient to have some of the lotion poured into the angle between the eye and the nose, while his head is thrown back, and then, by opening the lids and everting the lower one, to allow the fluid to run into the eye. This should be repeated two or three times during the day; it tends to constringe the dilated vessels of the conjunctiva, and thus accelerates the

Ointment.

stream of blood passing through them, inducing a more healthy action in the part. At night the patient should be directed to smear an ointment along the free edges of the affected eyelids:—Ung. hydr. ox. rubri dil. ʒss; cacao butter, ʒiij.

Atropine often useful.

Astringent lotions in some cases excite irritation and even pain in the eye; under these circumstances it is not advisable to persist in their use, but a weak solution of Atropine gr. ½ to the ℥j of water, dropped into the eye once a day will often be very beneficial, in combination with the red ointment.

Cold douche and compresses.

The pathological changes being confined in simple hyperæmia, to dilatation of the vessels, either through defective nervous influences or a faulty interchange between the blood and the tissues, we may rely upon the simple treatment above indicated to restore the parts to a healthy state; and, on the same principle, we may order the patient to use the cold-water douche to the closed eyelids, for ten minutes, night and morning. Cold compresses are also most refreshing, and may be applied over the closed lids with advantage for fifteen minutes at a time, especially after a day's work. A lotion to bathe the eyelids with, as follows, is useful in cases of this kind. Sp. æther. nit.; sp. æther. sulp. āā ʒj, sp. rosmar. ℥vj.

Rest.

When the hyperæmia depends on overstraining the eye, our first care must be to protect the organ by rest, and ordinarily fair usage; our eyes cannot stand with impunity all the wear and tear that we, of this restless age, are apt to force upon them.

Alteratives.

Abstinence.

Tonics.

Where the affection is associated with visceral disorder, we may often have to attack the congested conjunctiva through a judicious use of alteratives, and similar remedies, rather than by local applications. Frequently abstinence, as regards tobacco and alcohol, must be enjoined, overloading the stomach with food must be prevented, and a dose of blue pill and black draught administered. These means are as often required in one class of cases as tonics are in another. As an example of the latter, we may take the case of growing youths (students for instance), who, in addition to more or less general debility, suffer from hyperæmia of the conjunctiva. Although the use of astringents, and restriction as to the amount of reading and writing they perform, are doubtless called for in these cases, still a generous dietary, exercise, and iron must be prescribed, together with the cold-water douche, if we would effect a permanent cure.

Remove foreign body.

It is almost superfluous to remark that, if hyperæmia depends on the presence of a foreign body in the eye, the offending substance must be removed: if an inverted eyelash, for instance, it must be carefully extracted. In examining an eye, never forget to glance at the cilia, particularly at those growing near the inner or outer angle of the eye: a single hair may be sufficient to keep up such an amount of hyperæmia, as to render a patient unfit for ordinary work, and unless the offending object is removed, the disease will certainly persist. Hyperæmia of the conjunctiva, depending on hypermetropia, may be cured by a judicious selection of convex glasses, adapted to relieve the overstrained muscular apparatus of the eye: but as this subject, as well as that of congestion depending on retinitis, will be more fully treated of in a subsequent chapter, I shall leave it for the present.

Glasses for hypermetropia.

CATARRHAL CONJUNCTIVITIS.

MUCO-PURULENT, OR CATARRHAL CONJUNCTIVITIS, may be considered as an aggravated form of hyperæmia, with this difference, however, that the discharge from the conjunctiva, though still consisting chiefly of a watery fluid, contains albumen and shreds of muco-purulent matter; and further, that the muco-purulent matter possesses *contagious* properties; in this respect, therefore, the disease we are considering differs essentially from simple hyperæmia.

Contagious.

Pathology and Appearances.—In the early stages of muco-purulent conjunctivitis, we shall find that the vessels of the palpebral conjunctiva are principally affected, so that the position of the Meibomian glands is speedily concealed by the congested mucous membrane covering them; the inner surface of the lids appears of a uniformly red colour, the conjunctiva being slightly swollen, especially at the tarso-orbital fold; the semilunar fold and caruncle are also in a similar condition, and, as a general rule, both eyes are equally affected. In conseqence of this turgid state of the vessels of the conjunctiva, the villi are more prominent than in health; the loop of vessels contained in the papilla being not only congested, but serous effusion having taken place into its connective tissue, the basement

Palpebral portion red and swollen.

Villi turgid.

membrane covering the villus is distended, in the same way that a glove might be by the fingers of the wearer.

Orbital portion injected.

The vessels of the orbital conjunctiva are occasionally affected to such an extent, that the sclerotic is entirely hidden by the uniformly red and congested mucous membrane covering it. Under these circumstancs there is generally a good deal of *chemosis*, as it is called —a term employed exclusively of the conjunctiva, to indicate an œdematous condition depending on serous infiltration of the sub-mucous connective tissue. In the majority of instances, however, the vessels of the orbital conjunctiva are not so deeply injected as above described, but many large and separate vessels may be seen coursing over the sclerotic in a reticulate manner, from the palpebral conjunctiva towards the cornea.

Chemosis.

The amount of chemosis present varies very much in different cases; it is always most marked in the tarso-orbital and semilunar folds; in some cases it bulges the conjunctiva forwards, and causes it slightly to overlap the margin of the cornea. To the same cause—viz., over-distension of the vessels, we must attribute the patches of ecchymosis seen on both the palpebral and orbital conjunctiva, in cases of muco-purulent conjunctivitis; the hæmorrhagic spots are usually small but numerous, and doubtless depend upon rupture and extravasation of blood from some of the minute vessels of the mucous membrane.

Ecchymosis.

Eyelids swollen.

As a general rule the patient's eyelids are slightly swollen and red, particularly at their edges.

Secretion augmented;

The secretion from the lachrymal and conjunctival glands varies in character during the different stages of the disease; at the commencement it is augmented in quantity, but is normal in quality. As the congestion increases, the circulation through the vessels is impeded, and the first effect of this, observed in the secretion, is the presence in it of albumen; afterwards, as increased cell-formation is established in the epithelial layers of the conjunctival and conglomerate glands, we find a vast number of epithelial, together with mucous cells, mixed up with the serous fluid which escapes from the eyelids. The mucous appear to result from increased action of the conjunctival epithelial cells. I have frequently observed the mucous cells being formed in, and then extruded from the epithelium; while the viscous character of the secretion is referrible to the deliques-

becomes albuminous.

Afterwards muco-purulent.

cence of the intercellular basis. This muco-purulent matter usually collects in whitish flakes, which may generally be seen floating about in the tears, not mixing with them; and when the lower lid is everted, the latter escape, and the flakes of mucus generally become deposited on the surface of the conjunctiva, especially on the tarso-orbital fold.

The diseased action is not confined to the conjunctiva and lachrymal apparatus; after a time, the lining membrane of the Meibomian glands also participates in the irritation going on in their immediate vicinity; their secretion becomes altered in character, as well as increased in quantity, and accumulating on the margin of the lids during sleep, it dries and gums them together, so that on waking, the patient has often considerable difficulty in opening his eyes, until they have been washed, and the concretions removed.

Meibomian glands affected.

Lids cohere.

Subjective Symptoms.—Bearing in mind the fact that muco-purulent conjunctivitis is an advanced stage of hyperæmia, we should naturally expect the patient to complain of an augmentation of the symptoms characteristic of that affection. The conjunctival vessels being more intensely congested than in hyperæmia, the patient complains more urgently of a sensation as if grit or sand had fallen into his eye, and it is often difficult to persuade him that this symptom does not depend upon a foreign body lodged beneath the lids; the affected eye itches a good deal, and the upper lid feels to the patient as if it were stiff and heavy, especially after work or exposure to the glare of the sun or candle-light. The lachrymal secretion being increased, and the puncta more or less occluded by the swollen condition of the mucous membrane, the eye waters much, and a tear is apt to collect between the lids, and hanging in front of the cornea to cause some impairment of vision, until the patient wipes it away. These symptoms increase towards evening, and in the morning the patient awakes and finds his eyelids stuck together, by the dried secretion from the Meibomian glands.*

Sensation of grit in the eye.

Stiffness of the lids.

Lachrymation.

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* A difficulty of another kind is sometimes experienced in opening the lids, especially in the earlier and drier stages of the complaint, and in chronic cases; this depends on the roughness of the opposed conjunctival surfaces, and a diminution of the secretion by which they are ordinarily lubricated.

Pupil active.

The cornea remains bright and clear, and the pupil responds to the stimulus of light, indicating the fact that neither of these structures is involved.

General aspect.

A person suffering from muco-purulent conjunctivitis does not experience any actual pain in the eye or supra-orbital region, nor is there usually much intolerance of light, so that he often comes to consult us with his eyes wide open, and presenting those appearances of the parts which I have above described.

Prognosis.

An attack of conjunctivitis of this kind usually disappears in the course of a few days, unless its exciting cause should continue in operation; under which circumstances it may pass on into the purulent, or other forms of inflammation, or it may degenerate into a state of chronic hyperæmia.

Causes.

Atmospheric influences.

The Causes which induce muco-purulent conjunctivitis are numerous, but in the majority of cases it may be traced to atmospheric influences, such as cold or damp, or sudden changes of temperature. These are, however, not always sufficient to account for the sudden outbreaks of this complaint, which often has an epidemic prevalence, and that even in the summer months; but under these circumstances we must remember that contagion plays an important part in the propagation of the disease, and it often spreads in this way through a school, a regiment, or a community. Miasma, foul air from overcrowding, putrescent and irritating exhalations from drains and cesspools, are also sources of this form of conjunctivitis, and greatly aggravate its progress.

Contagion, and miasma.

Foreign bodies.

Foreign bodies lodged on the conjunctiva may give rise to muco-purulent conjunctivitis; for instance, it is not a very uncommon circumstance for an insect to find its way into the eye, and becoming impacted in the folds of the conjunctiva, to induce muco-purulent inflammation. Lastly, a muco-purulent conjunctivitis is apt to occur in the course of the various exanthemata.

Treatment.

Remove the cause.

Treatment.—The first object to be kept in view, in the treatment of muco-purulent conjunctivitis, is to remove, if possible, the cause of the disease. As a general rule there can be no difficulty in accomplishing this, should the inflammatory action depend on the presence of a foreign body; but if it be induced, as it too frequently is, from the prolonged action of dust, foul air, over exposure to the sun, or other irritating causes, it may be difficult, especially among the lower classes, to protect them from these deleterious influences.

Segregation.

Alteratives.

Belladonna.

In treating these cases, we should never overlook the fact that the affection is a contagious one, and therefore it is our duty to isolate patients suffering from it, as far as possible. The state of the patient's general health must be taken into consideration; the secreting organs will frequently be found at fault, and a little judicious starving in some cases, together with a blue pill, black draught, and colchicum, will do wonders, particularly if the individual is the subject of a rheumatic or gouty diathesis. There can be no greater mistake, than to order a patient astringent lotions to drop into the eye simply because he is suffering from muco-purulent conjunctivitis; applications of this kind do far more harm than good in many of these cases. If the patient suffers from ciliary pains and irritability of the eye, it is advisable to keep him in a dark room, and apply the extract of belladonna freely over the eyelids. A weak solution of sulphate of atropine may be advantageously dropped into the eyes in cases of this description. Hot poppy-head fomentations are often most grateful to the patient, and may be employed three or four times a day, the belladonna being smeared over the lids after the use of the fomentations.

So soon as the irritation has subsided, and the discharge from the eye is of a muco-purulent nature, astringents may be substituted for the atropine drops. A lotion composed of zinc chloride, or of nitrate of silver, grain j to the ℥j of water, should be applied to the surface of the conjunctiva three times a day. In cases where astringents of this kind seem to irritate the eye, a solution of tannin, gr. xx to the ℥j of water may be substituted, the extract of belladonna being smeared over the skin of the eyelids and temple at bedtime.

Should the discharge from the eye be copious when we first see the patient, or become so after treatment such as I have above indicated, we must employ a rather stronger solution of nitrate of silver, containing three or four grains to the ℥j, to the eye every six hours, in combination with atropine. Cold compresses should be kept over the closed eyelids for some time after each application of the astringent lotion.

Ointment to the lids.

It is advisable, under any circumstances, to order the patient to smear the glycerine and starch ointment, or a little cold cream, along the free margin of the lids at bedtime, so as to prevent them from sticking together during sleep; or an ounce of simple ointment, in combination with ten grains of the red precipitate, may be employed in the same way.

Alum lotion.

As the acute symptoms pass off, a lotion composed of acetate of alum, two grains to an ounce of water, may be substituted for the nitrate of silver. I need hardly add that, if practicable, the patient should abstain from work, and keep away from bright sunshine; neutral tint glasses, or a gauze shade, should be worn when he is exposed to glare or dust, and he should be cautioned against working by lamp or candle-light. If the eyes are overstrained, it is almost impossible to cure the conjunctivitis; they must have rest as well as medicine.

Rest and protection.

PURULENT CONJUNCTIVITIS,

varies in severity.

PURULENT CONJUNCTIVITIS.—This formidable disease varies much in intensity in different individuals and in different places; it is most destructive among the poor and ill fed, and those whose constitutions have been impaired by disease; but under any circumstances it too frequently ends in sloughing of the cornea, and partial, if not total destruction of sight.

Pathology and Symptoms.—It is impossible, as I have before remarked, to draw a line of demarcation between the termination of muco-purulent and the commencement of suppurative conjunctivitis, the latter being simply a more intense form of disease than the former. In all cases of purulent conjunctivitis in its early stages, hyperæmia of the mucous membrane exists, which rapidly passes on into the muco-purulent form of the disease; but in its first stage it would be impossible, in any given case, to say positively if the inflammation would advance to suppuration or not, although in the majority of instances all doubts on the subject will be cleared away in the course of a few hours. In fact, in cases arising from the inoculation of gonorrhœal or other contagious matter into the eye, symptoms of intense inflammation declare themselves very rapidly, and leave us no room for doubt as to the

Hyperæmia at first.

Passing into acute inflammation.

formidable nature of the disease with which we have to cope.

Nature of the changes in the conjunctiva.

Intimately connected with the stagnation of blood in the conjunctival vessels of an eye affected with purulent inflammation, are certain active changes set up in the part, resulting in increased cell-formation; the congestion, moreover, occasions a considerable amount of serous infiltration into the loose connective tissue of the lids, and from these combined causes the swelling and œdema of the parts arise. These pathological changes are similar in kind, but more deeply seated and intense, than those we have already described as taking place in the catarrhal form of conjunctivitis. The serous infiltration is deeper, there is a more rapid proliferation of cells, which are consequently less perfect, and tend to fatty degeneration. Hence the cell elements in the secretion are more abundant, the intercellular basis less consistent; there are more pus and fewer mucous cells; the flakes disappear, while the secretion becomes less viscous, and mixes more readily with the tears.

Cell proliferation.

Swelling of the lids variable,

soft and doughy.

The extent to which the eyelids are swollen in cases of this kind is not a safe criterion of the intensity of the disease. I have met with instances in which the eyelids were only slightly swollen, and yet sloughing of the cornea had supervened very rapidly; but whether the patient's eyelids be greatly swollen or not, they feel soft and doughy to the touch, and not, as in diphtheritic conjunctivitis, of brawny hardness. It is a mistake, however, to suppose that we can evert the lids, especially the upper one, in cases of purulent conjunctivitis, without giving the patient pain; in many instances the eyelids are much swollen, and it then causes the patient very considerable suffering to evert them.* I mention this fact, because authors speak of turning up the lids, and smearing caustic over the palpebral conjunctiva in cases of the kind, as though the proceeding were almost a matter of indifference to the patient. My experience leads me to a very opposite conclusion. I find that few adults can undergo this treatment, on account of the suffering it causes, and I have never seen a child sufficiently heroic to allow the application to be repeated.

Difficulty of everting them.

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* "Augenheilkunde," von K. Stellwag v. Carion, p. 354.

Conjunctiva of lids and globe thick and red.

The congestion of the conjunctival vessels is great, and comes on very rapidly in this form of disease. Both the palpebral and orbital portions of the conjunctiva are of a uniformly deep scarlet colour (Pl. II. Fig. 2); the former is thickly covered with engorged villi, which produce the velvet-like appearance above noticed; in some cases the villi are flattened and rounded from pressure against the eyeball.

Villi turgid.

Chemosis.

In cases where the serous effusion into the connective tissue of the conjunctiva is excessive, this membrane becomes so much swollen that the lids are thrust away from the eyeball; but the fibres of the orbicularis, contracting firmly, prevent the lids from being everted for some time. The distending force from within may, however, ultimately gain the ascendancy, and the lid will then be turned backwards on itself, in exactly the same manner as it is when we evert it in making an examination of the parts, acute ectropium in fact, resulting. This accident is more liable to occur in young children than in adults; ignorant attendants are apt, especially at night, to evert the swollen lids, in the attempt to apply drops or lotion to the eye. The accident may not be noticed till some hours afterwards, and in the meantime the fibres of the orbicularis at the line of eversion form a constricting band, which presses firmly on the part, and impedes the circulation of blood through the vessels of the everted portion of the lid; and unless the ectropium is speedily reduced, and the parts returned to their normal position, the conjunctiva is very likely to slough, and irrecoverable injury may be done to the eye.

Acute ectropium.

Risk of sloughing.

Closed puncta.

Another symptom, consequent on the swollen state of the conjunctiva, is that the puncta, at an early stage of the disease, are closed and thrust away from the eyeball, so that the tears cannot pass through them; this, combined with the hypersecretion of fluid from the lachrymal gland, causes a stream of tears to be constantly overflowing from the inner corner of the eye and running down over the cheek.

Lachrymation.

Ecchymosis.

When speaking of muco-purulent conjunctivitis, I mentioned that small spots of ecchymosis are generally to be seen in the conjunctiva; in the purulent form of the disease these hæmorrhagic effusions are not only numerous, but often of considerable size, as we might expect from the more intense congestion of the vessels which exists in the suppurative variety: but this ecchymosis is a matter of very small importance, as the effused blood becomes rapidly absorbed as soon as the inflammatory action subsides.

Secretion varies with progress of disease.

The nature of the secretion from the conjunctiva varies with the progress and character of the disease; at first it is watery, then it contains muco-purulent matter, and lastly it will be found to consist of pus often tinged with blood. In many cases the quantity of pus formed is by no means great, and we must not always expect a stream of purulent fluid to gush out from between the patient's eyelids the moment we separate them, although in many instances this is the case.

Increased temperature.

A tolerably accurate index of the intensity of the changes going on in the conjunctiva in purulent conjunctivitis is afforded us by the increased temperature of the eyelids, which may be measured with the thermometer, and which will be found to range several degrees above the normal temperature of the skin; in the muco-purulent and milder forms of conjunctivitis, there is no perceptible increase in the temperature of the lids.

Suppuration begins early.

In purulent conjunctivitis, as I have before mentioned, suppuration generally commences within forty-eight hours from the beginning of the attack, so that the first stage of the disease is of short duration; and this is one of the diagnostic symptoms between it and diphtheritic conjunctivitis. In the latter, suppuration does not come on until the fibrinous exudation has begun to degenerate and become disintegrated, a period usually exceeding five days, and until this time has elapsed there is no purulent discharge from the surface of the mucous membrane.

Pus infectious.

There can be no doubt as to the contagious nature of the pus in purulent conjunctivitis; this is the reason why both eyes are usually affected, the matter finding its way from the diseased into the sound eye, unless the strictest precautions are taken to prevent this accident.

The cornea deprived of blood.

Corneal Complications.—In severe cases of purulent conjunctivitis, the circulation in the part is impeded, on account of the blood stasis due to the inflammatory action. In addition to this, the swollen conjunctiva overlaps the margin of the cornea, and in many instances the chemosis is so great, that the cornea appears buried in the crimson folds of the mucous membrane. This effusion into the conjunctiva tends to augment the impediments to the circulation through its deeper layer of vessels; and these combined causes materially interfere with the passage of blood to the margin of the cornea, cutting off its supply of nutrient material, and frequently leading to rapidly advancing ulceration and necrosis of that important structure.*

Consequent ulceration.

A careful examination must be made.

We cannot, therefore, be too careful in examining the eye of a patient suffering from purulent conjunctivitis, to ascertain the condition of the cornea beneath the chemosed mucous membrane. Considerable difficulty, however, is often experienced in opening the lids in cases of this kind, for not only are they frequently much swollen, particularly the upper one, but the individual involuntarily resists our attempts to admit light into the eye. Under these circumstances, we should not hesitate for a moment to administer chloroform, particularly in the case of children. The patient's sight may depend upon the care with which we make our first examination; and any pulling or pressure on the lids is to be avoided, as deep ulceration of the cornea may exist; and if it does, the surgeon may unawares put a finishing stroke to the matter by pressing on the eyeball and causing the ulcer to give way. Irreparable damage would thus be done to the eye, which might well be avoided, if only five minutes were employed in administering chloroform before commencing the examination.

Chloroform should be given.

Caution.

I cannot insist too strongly on the point, that the principal danger of purulent conjunctivitis consists in the destructive effects it so often exerts upon the cornea, and that to this structure our attention must be mainly directed.

The commencement of this disorganizing process is sometimes seen in a general haze of the cornea, but more commonly as a patch or patches of grey infiltration, usually situated at the periphery. The ulceration follows at the margin of the cornea, beneath the chemosed conjunctiva, and unless the swollen mucous membrane be pressed backwards, the destruction progressing beneath it may not be recognised; the diseased action, however, advances, the cornea is perforated, and prolapse of the iris occurs, the centre of the cornea, it may be, looking bright and clear to the last.

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* Professor Stellwag seems to regard the contact of the purulent virus as an accessory cause of the ulcerative process. "It is probable," he observes, "that this ulcerative process has a near causal connexion with the true purulent secretion, and that its effect on the corneal substance may be excited, or at least favoured by a sort of decomposing action."

Ulceration concealed by chemosis.

Centre clear.

In other cases, the ulcer spreading completely round the margin of the cornea, the nutrition of its central portion is cut off; it becomes hazy, necrosis occurs, followed by a rupture of the cornea, and probably the evacuation of the greater part of the contents of the eyeball. These changes apparently take place very rapidly, so that a cornea, which in the morning perhaps looked bright and clear, in the evening is hazy, and on the following day may have sloughed away; not that the process absolutely occupies so short a time, for in all probability, had the chemosed conjunctiva been pressed backwards, and the margin of the cornea examined, we should have found its circumference deeply ulcerated, as above described.

Circular ulceration.

Rapid sloughing of the cornea.

In other instances of purulent conjunctivitis, suppurative keratitis sets in from an early stage of the disease: the cornea assumes the well-known and much-to-be-dreaded "moist wash-leather appearance"— a most hopeless condition of the parts, which has only to be seen once to be recognised again.

"Wash-leather" cornea.

Lastly, in a few instances, the cornea appears as though it had been stained with a solution of carbonate of lead, being of a pinkish white colour and semi-transparent. These changes seem to depend on fatty degeneration of the fibrous elements of the cornea, which consequently lose their tenacity, and become unable to resist the intra-ocular pressure; the cornea then gradually gives way, and bulges forward, particularly towards the centre, which may ultimately burst like an over-distended bladder, and through the rent thus made, a large hernia of the iris occurs. This particular class of cases is seldom marked by very acute symptoms, the chemosis is not a prominent feature of the disease, nor is there much purulent discharge from the eye; but these degenerative changes, gradually advancing in the fibrous structure of the cornea, indicate a most dangerous state of things when

Fatty disorganization.

Rupture.

Hernia of the iris.

occurring as a complication of suppurative conjunctivitis.

The patient relieved by rupture.

No sooner is the cornea destroyed by any one of the processes above noticed, than the patient experiences the greatest relief; the intra-ocular pressure being removed, the pain at once abates, the discharge becomes less, and the patient believes that all is going on well, whereas, as Mr. Dixon remarks, the surgeon knows but too surely that his patient's sight is lost for ever.

Condition almost hopeless.

But, as he further observes, "as long as any portion of the cornea retains its vitality, the case must not be abandoned in despair; for if only a small portion, less than a quarter of one cornea, can be saved from destruction, and its transparency retained, useful sight may be eventually gained by the operation of making an artificial pupil."* I am, however, able to offer even more substantial consolation than this, and to affirm that, even in the worst cases of purulent conjunctivitis, destruction of the cornea but rarely occurs, if the treatment I shall presently describe be carefully carried out; provided the patient is in pretty good health, and is brought under our notice at an early period of the disease.

Prevention.

Subjective Symptoms.—At the commencement of the attack, the patient will complain of the affected eye itching a good deal, as if sand or dust had got into it; but this symptom is of a very transient nature, corresponding to the first stage of the affection, which, as I have before remarked, seldom lasts more than thirty-six hours.

Pain severe in the second stage.

In the second stage the chemosis and swelling of the lids are often considerable, and the pain is frequently very acute, but by no means constantly in proportion to the swelling of the parts; it depends to a great extent upon the degree to which the deeper structures of the eye are involved, and upon the temperament of the patient. In all instances, pain in the eye, extending to the temple, is a constant symptom of severe purulent conjunctivitis, and one which the patient is sure to bring prominently to our notice. The pain usually increases towards bed-time, and by no means disappears when the suppurative stage comes on. In

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* "A Guide to the Practical Study of Diseases of the Eye," by J. Dixon, p. 49.

Ceases on rupture of the cornea.

some instances there is a sudden cessation of pain about the tenth day of the disease, but this frequently depends upon perforation of the cornea and the evacuation of the contents of the eyeball; the moment the intra-ocular pressure is removed, the patient experiencing relief.

Varies with severity of disease.

The pain of purulent conjunctivitis, however, varies according to the intensity of the disease: where the affection is comparatively mild, it may be almost absent, the patient simply complaining of a pricking, aching sensation in the eyelids, especially the upper one. In such cases the external inflammatory action has not been sufficiently severe to affect the circulation in the choroid, and consequently there is none of that implication of the ciliary nerves and intense pain in the eye, which is a marked feature of the more severe form of the disease.*

Constitutional symptoms trifling.

As a general rule, the constitutional disturbance which occurs in cases of suppurative conjunctivitis is of a very trivial character; there may be some amount of fever present, but it is not a noticeable feature of the disease, as it is in diphtheritic conjunctivitis. The patient complains of restlessness and want of sleep, but this is often occasioned by the anxiety of mind and the pain from which he suffers.

Intolerance of light.

In severe cases there is always marked intolerance of light; and although the lids may be so much swollen that the patient cannot open them, he still prefers being in a dark room, and the moment he is brought towards the light there is a gush of tears from between the lids, and an instantaneous increase of pain in the eye. In less severe cases the patient does not experience any great uneasiness from a short exposure to the light, but always prefers a dark room and the exclusion of as much light as possible from his eyes. In fact, the physiognomy of a person suffering from a bad attack of purulent conjunctivitis, in its second stage, is characteristic of the disease; his face is usually pale, and his countenance indicates pain and distress; he is led into your presence by a companion, being unable to see; the eyelids are more or less red and swollen, their free margins being usually of a scarlet colour, and pus is seen oozing from between

Physiognomy characteristic.

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* Middlemore, "Treatise on Diseases of the Eye," vol. i. p. 116.

them; the patient holds a handkerchief or his hands before his eyes, so as to screen them from the light as much as possible. It does not follow that both eyes are affected; but the sound one is usually kept closed, as exposure to light at once induces pain in the diseased organ.

Prognosis from the state of the cornea.

Prognosis.—In endeavouring to estimate the probable issue of a case of this kind, the condition of the cornea must chiefly engage our attention; if it is bright and clear, and no ulceration is going on at its circumference, the patient's health at the time being good, our prognosis may safely be a favourable one. If, on the other hand, ulceration has commenced, our opinion must be very guarded; and if sloughing of the cornea has begun, we can give the patient no reasonable hope of recovery; he may regain some amount of sight in the diseased eye, but at best it will be very imperfect.

Frequency of relapses.

In forming our prognosis, also, we must constantly bear in mind the fact that purulent conjunctivitis is very apt to relapse. A patient may apparently be on the high road to recovery, when suddenly a return of all the worst symptoms takes place, and his prospects of ultimate improvement become very much impaired. Even in apparently trivial cases I have seen relapses of this kind occurring, which, in spite of my best efforts, have terminated in serious damage to the eye.

Causes.

The Causes of Purulent Conjunctivitis.—This form of the disease is due, in by far the majority of cases, to contagion; infecting purulent matter from the eyes of another person, gonorrhœal matter, or the unhealthy secretions from the vagina, are capable among other similar agents of inducing purulent conjunctivitis.

Inoculation.

Other reputed causes doubtful.

It has been supposed that the disease may be propagated by means of dried purulent matter floating in the air, and becoming deposited on the conjunctiva. Insects no doubt may be one means of conveying the matter from the source of infection to the healthy eye.

Treatment.

Treatment of Purulent Conjunctivitis.—In purulent conjunctivitis our main efforts must be directed towards the preservation of the cornea. If the conjunctivitis were not the cause of ulceration of the cornea, we might very well leave it to itself, but as it is, unless we can reduce the inflammation going on in the mucous membrane, no amount of care and skill on our part can insure the safety of the cornea. In considering the treatment, therefore, of purulent conjunctivitis, I would divide the cases into two classes: the first to include the milder ones, in which the cornea is unaffected; the second, the more severe cases, in which ulceration of the cornea has already begun.*

Cases divided into two classes.

1. Where the cornea is free.

1. In the first class of cases, discarding all consideration as to the cause of the disease (unless in instances arising from the presence of a foreign body in the eye), or whether the patient be an infant or an aged person, but distinctly bearing in mind the fact that we are now discussing those cases which are not complicated with ulceration of the cornea, we should at once order a strong solution of nitrate of silver (one drachm to three of water) to be painted over the skin of the eyelids. Another, weaker solution (two grains to the ounce) should also be prepared, some of which may be dropped into the eye every second hour. These drops should be continued for twenty-four hours, and it will then be advisable to repaint the eyelids with the strong solution of nitrate of silver, and to continue the drops until the congestion of the conjunctiva has subsided, and the purulent discharge become thinner, and less profuse.

Paint the lids with arg. nit.

Drops of the same for eye.

In the majority of cases, it will probably be unnecessary to apply the solution of nitrate of silver over the skin of the eyelids more than twice, but the instillation of the drops into the eye should probably be continued for a week or ten days; by that time the active symptoms of the disease will almost invariably have disappeared (provided the patient has come under our treatment at the commencement of the attack), and a solution of two grains of sulphate of zinc to an ounce of water, to be dropped into the eyes two or three times a day, may be substituted for the nitrate of silver lotion. It is seldom necessary, however, to use the nitrate of silver drops every second hour, as above directed, for more than two or three days; after that we may generally order it to be dropped into the patient's eye every six hours, and subsequently twice a day.

The latter to be used for a week or so.

In cases of this kind the patient does not usually

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* Tyrrell "On Diseases of the Eye," vol. i. p. 62.

Fomentations. suffer from much pain in the eye, and the poppy-head fomentation with extract of belladonna smeared over the temple will probably relieve any pain that may exist; in some cases, however, especially if the patient complains of considerable pain in the eye, a few leeches applied about an inch from the outer canthus are very beneficial. Aperients. The state of the bowels should be attended to, and, as a general rule, a generous dietary allowed. Tonics. Quinine, and a moderate amount of stimulants, are as often called for as antiphlogistics; but the state of the pulse must be our guide in this matter.

Management of infants. The chief difficulty with which we have to contend, in treating the purulent conjunctivitis of infants and young children, arises from their resisting our attempts to drop the solution of nitrate of silver into the eyes. The child's head must be firmly secured, and the lids gently drawn apart, and the lotion having been dropped into the eye, the lids may be allowed to close. This Drops must be used. proceeding should be repeated three or four times, and the eyelids then bathed with tepid water, and the child allowed to rest for two or three hours, when the lotion will have to be used again in precisely the same way, the application being continued night and day, until the purulent discharge almost ceases. If it should be found more convenient to apply the lotion by a small syringe, by all means let an instrument of the kind be employed. What we must insist on is, that the nitrate of silver lotion is thoroughly well brought into contact with the inflamed surface of the conjunctiva.

Improvement rapid. In most cases, if this plan be strictly followed out, a very considerable improvement will be quickly noticed in the state of the child's eyes. Within forty-eight hours the little patient will begin to open them, and bear exposure to the light; the swelling of the lids and congestion of the conjunctiva diminish; and we may then substitute a solution of sulphate of zinc (one grain to an ounce of water), for the nitrate of silver, the lotion being used three times a day. We Relapses may occur. should bear in mind the fact, that a relapse is just as likely to occur in this as in any other form of the disease, and not entirely discontinue the use of the sulphate of zinc lotion until the child has perfectly recovered; and should a relapse occur at any time, and the discharge become purulent, we must resume the nitrate of silver solution, which is almost a specific in cases of this kind if properly applied.

As an illustration of the plan of treatment here recommended, in cases of purulent conjunctivitis in which the cornea is unaffected, I may quote the following history from my case-book :—

October 11th : K., aged twenty-five, a healthy-looking woman, states that up to within the last four days she had been in perfect health, and has never had anything the matter with her eyes. The present attack came on some four days ago ; the right eye commenced watering and itching a good deal, and the following morning it was red, painful, and swollen ; in fact, in much the same state as it is now.

Case.

Acute accession.

Redness and swelling.

Towards the evening of the second day from the commencement of the affection, she came to the hospital for relief. I found the eyelids, especially the upper ones, considerably swollen ; their margins were covered with pus, which was oozing from the inner corners of the eyes. On everting the eyelids, the conjunctiva in either eye was found to be of a uniformly deep scarlet colour and swollen, the villi prominent, and looking like granulations. There were numerous spots of ecchymosis on the surface of the conjunctiva, it was also chemosed, and slightly overlapping the margin of the cornea ; the cornea, however, in both eyes was healthy, with the exception of a narrow rim of superficial ulceration near the superior margin of the right one.

Purulent discharge.

Commencing ulceration.

The patient complained of pain in the eyes, which increased towards morning ; it extended to her temples, but was not sufficiently severe to keep her awake during the night. She had no fever or constitutional symptoms : bowels regular ; appetite good. It appeared certain that she had not been suffering from gonorrhœa, nor, as far as we could ascertain, had she been exposed to the influence of any contagious matter.

Pain.

Ordered, at 7 A.M., to bathe the eyes constantly in tepid water ; a strong solution of nitrate of silver in water to be painted over both eyelids, and a solution of three grains of nitrate of silver to the ounce of water to be dropped into the eye every second hour. Full diet.

Arg. nit. to the eyelids and conjunctiva.

These orders were strictly carried out, and on the following day, the 13th of October, I found the swelling of the eyelids much reduced, the conjunctiva apparently in the same condition; but as the eyes had been kept perfectly clean, I was unable to judge of the amount of purulent secretion. The lids were again painted over with the strong nitrate of silver solution, and in fact the treatment of the previous day was continued.

Rapid improvement under treatment.

On the 14th I found a marked improvement in the eyes; the swelling of the lids was much diminished, the patient could open them, and did not suffer from intolerance of light; the chemosis was almost gone, and the narrow ulcer in the upper part of the right cornea was covered with vessels. I ordered the lotion to be applied every six hours, the nitrate of silver to the lids to be discontinued On the following day, the improvement continuing, I diminished the strength of the drops to one grain of nitrate of silver to an ounce of water, and it was employed less frequently. The patient recovered without a relapse, and was pronounced cured twenty days after she first came to the hospital.

In some cases, circumstances may render it impossible for us to depend on the nitrate of silver lotion being regularly and effectually dropped into the eye, and we may then order four grains of the sulphate of alum to an ounce of water to be injected between the eyelids with a small glass syringe, every thirty minutes during the day, and two to three times during the night.

2. Cases where the cornea is involved.

Apply caustic to conjunctiva of lids.

2. I now proceed to consider the treatment of the second class of cases—that is, those in which the cornea has become implicated, either during, or prior to the commencement of our attendance on the patient. It consists in applying caustic to the surface of the palpebral conjunctiva and semilunar folds: there is no necessity for touching the orbital mucous membrane.

The "dilute pencil."

With regard to the caustic to be used in cases of this kind, solid nitrate of silver should never be employed, but a pencil, composed of equal parts of nitrate of silver and nitrate of potash, or of one of nitrate of silver and two of nitrate of potash. A pencil of this kind is easily prepared by fusing the proper proportions of the salts together, and allowing the fluid mix-

Its advantages.

ture to run into a fine glass tube: it solidifies immediately, and is then fit for use. The reason why we employ a dilute caustic pencil in these cases is, that our object is simply to destroy the epithelial layers of the conjunctiva, and not to cause sloughing of its connective tissue, which pure nitrate of silver might do, and thus lead to the formation of a conjunctival cicatrix, and very probably contraction of the mucous membrane. The rough surface thus formed would be likely to keep up irritation in the part, and by constantly rubbing against the cornea, ultimately induce opacity. The cornea, however, is hardly likely to escape immediate destruction if solid nitrate of silver is applied to its surface.

Method of using the caustic.

Application must be thorough.

Many patients suffering from purulent conjunctivitis become nervous and irritable; they cannot and will not bear much increased pain, and under these circumstances it is sometimes advisable to let them inhale a little ether before applying caustic to the surface of the conjunctiva; under any circumstances the patient should be seated or laid on his back before a window, so that the inflamed eye may be thoroughly illuminated; the lower lid is then to be carefully and fully everted, the conjunctiva being wiped dry with a bit of linen rag, and the caustic pencil is to be applied over the entire surface of the palpebral mucous membrane, particularly over the tarso-orbital fold. The instant the caustic has been applied, a white film forms over the part, and as soon as this appears, an assistant should drop a little cold water over the everted lid, so as to decompose and wash away any excess of nitrate of silver that may be present. The lower lid may then be returned to its normal position, and the upper one treated in precisely the same way. When the latter is much swollen, we shall experience considerable difficulty in smearing the upper tarso-orbital fold of the conjunctiva; it is absolutely necessary, however, that the whole of this portion of the mucous membrane, as well as the semilunar folds, should be brought in contact with the caustic pencil.

Discharge lessened by the caustic.

A pencil of nitrate of silver, applied in the way above described to the surface of the conjunctiva, at once destroys its epithelial layers, from which the purulent discharge is produced; so that, until the epithelium has re-formed, the discharge from the inflamed eye will diminish very perceptibly. The length of time necessary for completing these changes varies under different circumstances, but, as a general rule, new layers of cells will have replaced those we have destroyed in about twenty-four hours, and with their growth the purulent discharge from the eye will return. This will be the sign for the necessity of a re-application of the caustic; in fact, as soon as the pus again appears after our first application, whether it be in twelve, twenty-four, or thirty-six hours, so soon must we re-apply the caustic, in precisely the same way as I have just described; but a somewhat weaker pencil, composed of one part of nitrate of silver, and three of nitrate of potash, will, as a general rule, be sufficiently strong after the first application. It may be necessary to continue this treatment for five or six days, before the excessive action going on in the inflamed conjunctiva will have been overcome, and the purulent discharge cease; but, as a general rule, after each application of the caustic, the pus will take a longer time to form, and will ultimately disappear altogether.

Rules for re-applying it.

M. Wecker's explanation of the action of the caustic is, that the hyper-action going on in the part is caused by the sluggish circulation of the blood through the vessels of the inflamed tissue; the application of nitrate of silver by altering this abnormal action causes the stream of blood to pass more rapidly through the part, and thus improves the circumstances of the tissues so far as their nutrition is concerned. To keep up this action of the caustic, he advises the application of cold compresses to the eyelids immediately after the cauterization. The compresses should be continued, if possible, without intermission, for they not only prevent the vessels from again dilating, but they wash away the abnormal secretion, and thus keep the eye perfectly clean—a most important point to attend to in such cases. The cold compress may be made by taking pledgets of lint sufficiently large to cover the eyelids, which should be laid on a lump of ice until quite cold, they must then be placed on the lid, and changed when they become in the least warm. Pledgets of this kind should be kept on the ice in rotation, so as to maintain a constant cold surface to the inflamed eyelid. The congestion being thus temporarily overcome, a more rapid circu-

Operation promoted by cold compresses.

Cleanliness important.

lation of blood takes place through the vessels, the nutrition of the parts is re-established, and the vessels are then more likely to retain their normal calibre, the healthy blood acting as a stimulant to their contractile tissue.

Syringing needless.

There is no necessity for syringing out the eye in order that we may keep it clean: it is quite sufficient to evert the lids slightly, and allow a little cold water to trickle into the eye, from time to time.

Recapitulation.

M. Wecker insists upon the importance of attending to the foregoing rules with regard to the use of nitrate of silver, which I shall therefore briefly recapitulate. It should never be employed until suppuration has commenced, otherwise it may do positive harm. Having applied it, wait before using it again, till the whole of the deposit which it has formed on the surface of the conjunctiva has disappeared, and suppuration has been re-established; if this is not done, we shall apply the caustic to the denuded basement membrane, which will be likely to damage this delicate structure, and the connective tissue beneath it, and would be followed by the formation of cicatrices, and a permanently rough state of the conjunctiva. As I before observed, our only guide as to the frequency with which the cauterization should be employed is the appearance of the mucous membrane: as soon as pus re-forms we may be sure that the epithelium has been reproduced, and may therefore with safety resume the use of the diluted pencil. If these rules are attended to, there is no fear of our cauterizing an eye affected with diphtheritic conjunctivitis in its early stages, or of any other of those mishaps taking place, a combination of which has thrown even this sovereign remedy into disrepute with some surgeons.

The orbital conjunctiva should be deeply incised.

With regard to the management of the orbital conjunctiva, which has been left untouched by the nitrate of silver, but which is swollen and probably overlapping the cornea, it is advisable to make four or five incisions through the mucous membrane, radiating from its chemosed portion, which overlaps the cornea, outwards as far as the eyelids.* I would make at least four such deep incisions down to the sclerotic: they should be made with a cataract knife, or some such sharp-edged instrument, so as not to lacerate the tissues. There can, I think, be no doubt that, by cutting through the swollen conjunctiva in this way, we relieve the pressure which the chemosis exerts upon the deeper layer of vessels, and thus give the cornea a chance of receiving sufficient nourishment to keep it alive. The only objection advanced against these deep incisions is, that in healing four cicatrices must be left in the conjunctiva. I do not, however, regard this objection as of any moment, when placed in opposition to the fact, that by this means we may do much towards preserving the integrity of the cornea, which is probably threatened with immediate destruction.

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* Lectures "On Diseases of the Eye," by J. Morgan. 2nd edit. p. 72.

Value of incisions.

Objections.

I am no advocate, however, for repeated and numerous incisions through the chemosed conjunctiva; the operation should be performed as I have described, and as it is our object to relieve the congested vessels, we must encourage the bleeding from the wounds which we have made by keeping the lids open, and bathing the parts with warm water for ten minutes or so. If we allow the lids to close immediately after the conjunctiva has been incised, clots of blood form beneath them, and the pressure which these exert on the vessels stops the hæmorrhage, and defeats the principal object which we had in view in making the incisions. These clots must therefore be prevented from forming for the space of about ten minutes; the lids may then be closed, and the cold water compress applied.

Encourage bleeding.

It will seldom be advisable to repeat these *deep* incisions into the mucous membrane, but after the palpebral conjunctiva has been smeared over with the caustic pencil, we may perhaps scarify the chemosed orbital mucous membrane, making *superficial* incisions in all directions, and then endeavour to excite hæmorrhage from the divided vessels, by the application of warm fomentations.

Superficial incisions may be repeated.

With regard to the state of the cornea and its treatment, we must in the first place make a thorough examination of the part, and its condition cannot be too carefully considered; for upon this inspection, and upon the treatment it suggests, the patient's sight in many cases depends.

Treatment of corneal complications.

The danger which we have to fear, if perforation of the cornea takes place, is that opacity will ensue, or a staphyloma of the iris occur, the elastic structures behind the iris pushing it through the opening in the cornea, and when in this position, preventing its return to its normal situation in the anterior chamber.

Danger of perforation.

In cases where a portion of the cornea is so far destroyed by ulceration, that its posterior elastic lamina alone remains intact, it may happen, at any moment, that this delicate structure will be burst open by the distending force behind it; we should therefore relieve the intra-ocular pressure by puncturing the cornea with a needle, and allowing the aqueous to escape. This little operation of paracentesis of the cornea, under these circumstances, is often attended with the happiest results: it not only prevents the formation of a staphyloma, but, by diminishing the intra-ocular pressure, it relieves the tension of the eyeball, and hence also the ciliary neurosis from which the patient often suffers to an intense degree. I believe I am tolerably safe in saying, that we are far more likely to err on the side of non-interference, than we are to open the cornea too often under these circumstances. The puncture through the cornea should be made near its junction with the sclerotic, and the point of a broad needle must only be allowed just to enter the anterior chamber, otherwise the lens may be injured; but beyond this caution, which is not peculiar to these cases, no particular rules are necessary for this operation. It is by no means always sufficient to perform paracentesis once, in the treatment of a case of this kind; the puncture made in the cornea heals within twenty-four hours, and the aqueous humour rapidly re-forms, so that it will very probably be necessary to open the cornea a second, or even a third time.

Paracentesis of cornea,

Relieves dangerous tension

and pain.

Precaution as to lens.

Repetition of puncture.

To sum up then: in the majority of cases of the class we are now considering, we shall have—1st, to make a thorough examination of the eye, and should we find the cornea ulcerated, we must 2ndly, apply a pencil of dilute caustic to the palpebral mucous membrane and semilunar folds; 3rdly, incise or scarify the orbital conjunctiva; and 4thly, puncture the cornea, if we find that one or more deep ulcers exist, but have not yet eaten through it. Lastly, if the eyelids are swollen, it is of the greatest importance to paint the skin over

Summary of local treatment.

them with a saturated solution of nitrate of silver. Cold compresses may then be applied to the eye.

Use of atropine. We have still, however, one important adjunct to our treatment, and that is the instillation of a solution of atropine (one grain to a drachm of water) into the eye; these drops may be applied every six hours. The object of this treatment is to paralyse the intra-ocular nerves, together with those supplying the cornea, and by relieving the tension of the ciliary muscle and cornea, to lessen the chances of the latter giving way, if partially destroyed by ulceration. The iris also being retracted when under the influence of atropine, its vessels are somewhat empty, and less aqueous humour will therefore be secreted, so that the internal pressure will be reduced; moreover, if the cornea gives way, the iris is less likely to be forced through the opening, than if it be allowed to remain in its normal position in the anterior chamber.

General measures. The above may be considered as the special and necessary treatment for cases of purulent conjunctivitis, complicated with lesion of the cornea. We may now consider one or two points bearing on the general treatment of such cases, whether complicated with ulceration or not; and probably one of the most important circumstances to attend to is the protection of the sound eye, if only one is affected, since the purulent secretion from the diseased eye is very apt to get into the sound one, and induce a similar disease. **Guard sound eye.** If, therefore, we can protect the sound eye by a pad of cotton wool and a bandage, we shall be doing the patient most valuable service. The patient himself will readily understand the advantage of this proceeding, and submit to the trifling discomfort of having his sound eye closed, so as to protect it from purulent infection.

Relieve pain. The pain from which many patients suffer in this disease may be relieved by the application of the extract of belladonna over the forehead, and the administration of chloral. We shall often have to use the latter drug in full doses at bed-time, for it is then that the pain generally increases, and prevents the patient from sleeping.

Leeches seldom useful. With regard to the application of leeches, I would simply say, that in a case of purulent conjunctivitis, occurring in a plethoric individual, by all means apply six or eight leeches to the temples. But, on the other hand, no more dangerous rule can be laid down than that, because a person is suffering from pain and purulent conjunctivitis, leeches are to be applied in an indiscriminate manner. My own experience would lead me almost to reverse this rule, but in practice it will be found impossible to lay down any invariable directions on the subject. It would be as absurd to deplete a weak, anxious, and anæmic patient labouring under purulent conjunctivitis, as it would be to abstain from the practice in all cases: our common sense must guide us in the matter.

Discretion in the use of depletives.

Stimulants and tonics.

So far, however, from leeches being always useful in purulent conjunctivitis, I am inclined to think that stimulants are more often required; rum mixture, with quinine and morphia, being frequently called for, together with a generous diet; the state of the patient's pulse will be our best guide as to the extent to which this practice should be carried. In many cases the infusion of bark with ammonia will prove of the greatest benefit: should it seem to increase the pain in the eye, it may be discontinued, but if it has no such effect, it is more than probable that the patient will improve under its use.

Diaphoretics and laxatives.

I have before remarked that, as a general rule, purulent conjunctivitis is not accompanied by any marked constitutional symptoms. Should the patient be feverish, diaphoretics will be useful, and, under any circumstances, we must be careful to regulate the action of the bowels with mild laxatives if necessary. But as purulent conjunctivitis has nothing to do with a faulty state of the liver or stomach, we should not launch out at random with purgatives or drugs of this description, in the hope of improving the state of the secretions—as the phrase is. These drugs are beneficial when called for, but, as a general rule, are harmful in the class of cases now under our consideration.

Mercury worthless.

With regard to the use of mercury in the treatment of this disease, without entering upon any discussion of the reputed power of this drug to cut short the inflammatory process, I am bound to observe that in cases of suppurative conjunctivitis I should never dream of ordering its administration.

Pure air.

Pure air, the best of all tonics, must, if possible, be obtained; and all unnecessary confinement to bed, or to one room, be avoided.

Preventive measures: Importance of segregation, and cleanliness.

We cannot too strongly insist upon the enforcement of absolute cleanliness, and, as far as possible, segregation, among patients suffering from purulent conjunctivitis. The attendants must be strictly warned as to the danger they run from contact with the purulent discharges. Cases of purulent conjunctivitis should not be admitted into a general hospital, unless they can be isolated; and the strictest orders should then be given, that the dressings or rags employed should be burnt after use. Washing utensils, and in fact everything brought in contact with the patient, should be retained for his special use. If purulent conjunctivitis should affect a child at school, he should immediately be separated from his playfellows; and the same remark applies to soldiers, and, in fact, to collections of individuals, whether in families, schools, regiments, or any other condition of society.

DIPHTHERITIC CONJUNCTIVITIS. Fortunately rare. Prevails where diphtheria is endemic.

DIPHTHERITIC CONJUNCTIVITIS.—This is, at present, a comparatively rare form of disease in this country.* In some parts of Germany, however, the havoc which diphtheritic conjunctivitis commits among the lower classes is fearful, for when once a patient has been attacked with it, his chances of recovering his sight are even less promising than in cases of purulent conjunctivitis; the truth being that the affection of the conjunctiva is simply a local manifestation of a more general, and very grave form of disease, in which any inflammatory affection of the mucous membrane is apt to assume the unhealthy and dangerous type which is characteristic of the malady.

Exciting causes various.

Unless, therefore, diphtheria be endemic, we are hardly likely to meet with instances of this kind of conjunctivitis; but, on the other hand, in districts where it prevails, if a person be susceptible of its influence, any cause inducing local irritation in the conjunctiva may give rise to the disease. In this way, the discharge from the eye of a patient suffering from purulent conjunctivitis, may be said to produce the diphtheritic form of the disease.

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* See "Maladies des Yeux," par M. Wecker, vol. i. p. 70; Cyprien Raynaud, "Thesis," Paris, 1866; "Lehrbuch der Praktischen Augenheilkunde," von K. Stellwag von Carion, p. 378, 1864, Wien.

Pathology and Symptoms.—If we bear in mind the characteristic features of diphtheria in other situations, we shall readily comprehend the nature of the phenomena induced when it attacks the conjunctiva. The same tendency manifests itself here, as in the mucous membrane of the fauces and other parts of the body, for a fibrinous formation to occur, not only on the surface, but also in the connective tissue of the mucous membrane; the eyelids become swollen, hard, and brawny, so that it is with difficulty they can be everted, or, in many cases, even separated from one another, and in attempting to drag them apart we often put the patient to very great pain.

Fibrinous brawny exudation.

On examining the conjunctiva, we shall find it of a buff tint, streaked here and there with a reddish coloration, the inner surface of the lids presenting a mottled appearance. This arises from the buff-coloured fibrinous formations which infiltrate the part, exerting pressure on the vessels and stopping the circulation through their smaller branches; some of the larger vessels remain patent, while others give way, and their altered contents, staining the fibrinous formation around them, produce the mottled appearance referred to.

Conjunctiva, buff and mottled.

The contrast, therefore, between the condition of the mucous membrane of the lids, in this the first stage of diphtheria, and that of purulent conjunctivitis, is very marked: in the latter, the mucous membrane is swollen, and of a uniformly deep scarlet colour, with spots of ecchymosis scattered over its surface, the enlarged and prominent villi giving it almost the appearance of a granulating sore; whereas in diphtheritic conjunctivitis the mucous membrane is of a buff or drab colour, comparatively smooth, mottled over with superficial patches of exudation and extravasated blood, and a few large and contorted vessels are usually seen on its surface.

Not red and villous.

If we attempt to remove any of this fibrinous formation, we shall find that it adheres firmly to the conjunctiva; we may detach it, but it breaks away in shreds, and from the jagged surface of the wound which is left, a bloody, serous fluid oozes away; the formation, in fact, is by no means limited to the

Exudation patches deeply connected.

surface of the conjunctiva, but exists principally in the sub-mucous connective tissue.

The changes and appearance of the conjunctiva above described are not confined to the eyelids; the same condition exists in the mucous membrane covering the sclerotic, the fibrinous formation infiltrating the conjunctiva throughout the whole of its extent, and too often extending to the cornea.

1st stage: exudation.

The period, during which the formation is being produced in the connective tissue, may be considered as the *first stage* of diphtheritic conjunctivitis; it usually lasts about six days, and is accompanied with fever and great pain in the eyes, extending to the temples and head; this pain is terribly increased if we attempt to open the eyelids, which are swollen and of brawny hardness. The temperature of the part is sensibly increased. The secretion at this period is scanty and serous. As a general rule, both eyes are affected, the disease being, as I before remarked, a local manifestation of a general disorder.

Pain and fever.

2nd stage: degeneration of exudates.

The *second stage* is one of reaction, degenerative changes taking place in the fibrinous exudations, which become softened and broken down. The detritus thus produced, together with pus cells from the connective tissue, and disintegrated blood corpuscles, are thrown off from the surface of the conjunctiva as a bloody, purulent discharge, containing shreds of fibrinous substance, supposed to have very irritating properties. The appearance of the everted lids is now completely altered, and nearly approaches that of the second stage of purulent conjunctivitis. The vessels are dilated and turgid with blood, the surface scarlet, but still presenting some patches of yellow exudation; the discharge is abundant. The patient is now almost free from pain.

Free discharge.

Hyperæmia.

The second stage varies in its duration, in proportion to the amount and depth of the primary croupy infiltration: if this has been great, the suppurative stage will be prolonged, and the reverse if it is scanty or superficial.

3rd stage: cicatrization.

In the *third stage* of the disease the inflammatory action subsides, and the effects of the previous changes which have taken place in the conjunctiva become apparent. Of these, the destruction of the sub-conjunctival tissues, consequent on the deleterious influences exercised by the fibrinous formation on the part, is most obvious; and in the reparation of the damage thus done, cicatrices are formed, which, in contracting, press upon and obstruct the few remaining vessels of the conjunctiva, so that the mucous membrane may at length be entirely destroyed, and replaced by white, glistening, cicatricial tissue. The duration of this stage will vary with the amount of destruction already effected, but, like most reparative processes, it is usually prolonged.

Diagnosis.

Diagnosis.—M. Wecker states that the severity of the three stages of diphtheritic conjunctivitis varies in different individuals, and that if the first stage runs a rapid course, the case may be mistaken for one of purulent conjunctivitis; with regard to treatment, however, no danger would arise even if a mistake of this kind were to occur, for a solution of nitrate of silver, or the dilute caustic pencil, would be the agents upon which we should rely under any circumstances.

Milder forms mistaken.

It is hardly necessary to mention that cases of diphtheritic conjunctivitis are not to be mistaken for cases of conjunctivitis occurring among people in a low state of health, on whose conjunctivas false membranes are apt to form; for beyond a somewhat similar appearance of the parts at first sight, there is no analogy whatever between the two forms of disease. These false membranes may be readily detached from the surface of the conjunctiva, the mucous membrane appearing of a florid red colour beneath them, whereas in diphtheritic conjunctivitis we can only detach broken shreds of the fibrinous exudation, the surface of the wound presenting a yellow granular appearance, from which a yellowish-red serous fluid exudes.

Conjunctivitis with false membranes.

Complications and Results.—As in suppurative, so in diphtheritic conjunctivitis, it is the structural changes to which the cornea is liable which render the disease so dangerous to the patient's sight; and, unfortunately, the virulent character of the affection too often defeats all our attempts to save the eye.

Dangers to the cornea.

The danger to the cornea is twofold: First, the fibrinous exudation may infiltrate its laminated structure, and in degenerating, completely destroy it. Thus we sometimes find, on opening the lids of a person suffering from this affection, that the cornea is of a yellowish-grey colour, owing to this infiltration of its

Total destruction,

tissue; and when the second stage of the disease is established, the cornea appears to break down *en masse* with the exudative material, a large staphyloma resulting. In other cases a deep circumferential ulcer may be seen surrounding the cornea,—a most dangerous symptom in this disease, for in spite of all our care the ulcer generally spreads rapidly, a few hours often sufficing to complete the mischief, and the cornea giving way, the eye is destroyed. This ulcerative process is sometimes peculiarly treacherous: the cornea at first looks hazy, as if affected with keratitis; this condition having lasted for a few days, the anterior and middle layers become disintegrated and destroyed. On examining the eye, at first sight the cornea may appear bright and clear; a closer observation, however, will convince us of the fact, that the posterior elastic lamina alone remains intact, and is bulged forward from the pressure of the aqueous fluid behind it; nor can it stand this tension long; it is almost certain to burst open, and then the lens, the aqueous humour, and a portion of the iris are protruded through the wound.

Peripheral ulceration,

insidious and disastrous.

Secondly, if the patient escapes these evils, and the cornea is not destroyed during the active stages of the disease, it may still suffer at a later period; the rough cicatrices which form during the third stage, and at length replace the palpebral conjunctiva, by constantly rubbing against the surface of the cornea, induce opacity of its structure, and ultimately loss of sight. Nor does this complete the list of misfortunes, for in course of time the cicatrices contract, and in contracting they shorten and displace the ciliary margin of the lid, inducing a most obstinate form of entropium. Lastly, in the reparative process, the opposed surfaces of the palpebral and ocular portions of the conjunctiva are apt to become adherent, and the conjunctival sac obliterated.

Secondary opacity,

from cicatrices.

Entropium.

Symblepharon.

Prognosis.—From the foregoing account, it is evident that a favourable termination can rarely be looked for. If, then, the first stage has been severe, we cannot but be extremely anxious as to the result; disorganization of the cornea is almost sure to occur, and we must frame our opinion accordingly. Even in apparently mild cases, our prognosis must be very guarded, for, like purulent conjunctivitis, the disease

Prognosis unfavourable,

or guarded.

subject to relapses, and a case which at first appeared favourable may be less so afterwards.

Recapitulation of symptoms.

Recapitulation.—Before leaving the subject, I will briefly recapitulate the symptoms of diphtheritic conjunctivitis. It may be divided into three stages: in the first, fibrinous formation occurs; in the second, this is broken up and removed; and in the third and last stage, cicatrization and reparation of the damaged conjunctiva take place.

The first stage may last from five to ten days; it is usually accompanied with fever, and the patient suffers great pain in the eye and neighbouring parts; the swelling of the lids is of brawny hardness. On separating them, the conjunctiva will be found of a pale yellow or buff colour, with a few distended vessels coursing over it, and here and there some spots of ecchymosis may be seen; a yellowish serous fluid, sometimes streaked with blood, exudes from the surface. The cornea, in the majority of cases, will be found to be more or less opaque, as if stained with a solution of carbonate of lead.

The second, or suppurative stage of the disease, is of variable duration. The patient is now almost free from pain, but the discharge is often very profuse, and pours away from the eye directly the lids are open. It has assumed a purulent character, being, in fact, a mixture of pus, disintegrated diphtheritic formation, and blood. The conjunctiva is swollen and of a bright red colour, but scattered patches may still be seen. It is in this stage of the disease that we may expect to find rapid and destructive changes going on in the cornea; it may appear bright and clear to a superficial observer, but the appearance may be delusive, and destruction far advanced. In some cases, suppuration having commenced, the cornea looks somewhat like a piece of moist wash-leather; in others, deep and rapidly extending ulceration may be going on at the margin. It is very seldom that the cornea is found in a normal condition throughout the suppurative stage of the disease.

The third stage of diphtheritic conjunctivitis consists in the formation of cicatricial tissue, by which the mucous membrane is replaced. As, therefore, the vascularity of the second stage of the disease gradually subsides, and the discharge ceases, the inner surface of the lids assumes a glistening, white, and puckered aspect. This new tissue is very apt to contract and produce entropium; and the rough surface which it constantly opposes to the cornea generally gives rise to opacity; so that supposing the cornea has escaped uninjured through the second stage of the disease, the patient will now be in imminent danger of losing his sight from these secondary changes.

Causes.

Causes of Diphtheritic Conjunctivitis.—The causes which give rise to this form of conjunctivitis are doubtless those local influences, whatever they may be, which engender or rather favour the growth of the contagium which causes diphtheria. It is met with in districts where diphtheria is endemic; and the disease has been known to spread from the conjunctiva to the nares, mouth, and throat. On the other hand, it is equally certain that the secretion from a mucous membrane attacked by diphtheria, is capable of propagating a similar form of disease in an otherwise healthy eye; it is, in fact, a highly contagious affection, and hence arises the necessity for taking every precaution to prevent the discharge spreading from a diseased to a healthy eye.

Endemic influences.

Contagion.

Diphtheritic conjunctivitis is most apt to occur among children under eight years of age, and in the majority of instances both eyes are affected.

Treatment.

Treatment of Diphtheritic Conjunctivitis.—Diphtheritic conjunctivitis being a local manifestation of a very intractable form of disease, it is almost impossible effectually to ward off the injurious consequences which too often follow its invasion.

Continental practice.

Antiphlogistics.

Some German practitioners advocate an antiphlogistic plan of treatment proportioned to the sthenic character of the affection—namely, the energetic application of cold to the part, extensive local bleedings, and the severest antiphlogistic regimen. Others would add the administration of mercury in large and repeated doses, so as to bring the patient under the influence of this drug as speedily as possible; calomel and mercurial inunction are, in fact, recommended *ad libitum*, and appear to be the means upon which they chiefly rely to stay the progress of the disease. They have been closely followed by other continental practitioners: thus, in the first stage of diphtheritic conjunctivitis, M. Wecker employs cold water compresses to

Mercury.

the lids, and he also recommends the application of leeches to the temples; but above all things he insists on the administration of calomel every two hours. As soon as the patient is salivated, he affirms that the conjunctiva loses its buff-grey appearance, the second stage of the disease being speedily established. He speaks favourably, also, of the effects of tartar emetic in relieving the feverish symptoms.*

Certainly, as our continental brethren have had the most experience in diphtheritic conjunctivitis, these methods of treatment demand our careful consideration, but my own experience would dispose me to adopt a very different method, and one which has been very generally sanctioned both in England and America in the treatment of diphtheria.† I rely more upon large doses of the sesquichloride of iron, combined with chlorate of potash, than on any other drugs, in the first stage of the disease: thirty drops of the tincture of the former, together with twenty grains of the chlorate of potash, may be administered every three hours, and this in spite of the fever which generally attends the outset of the affection. The state of the bowels must be attended to; hot baths at bedtime often induce perspiration and quiet the patient. As a general rule, a lowering plan of treatment is to be avoided; on the other hand, soup and a generous, though non-stimulating dietary are demanded. Mor-

Efficacy doubtful.

Tr. ferri mur.
Pot. chlor.

Nutrients.

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* Dr. Pagenstecher reports on fourteen cases treated "by scarifications and the energetic application of cold in the diphtheritic, caustics and atropine in the secreting, stages. Six did badly, the rest were more or less benefited."—*Ophthalmic Review*, vol. i. p. 190.

Professor Stellwag, while fully adopting the antiphlogistic method in the active stages of the disease, rejects mercury and other reputed *antiplastics* as "absolutely and certainly inefficacious."

See also *Ophthalmic Hospital Reports*, vol. v. p. 363, where the disease is reported to have advanced rapidly, in spite of calomel.

† The American editors of Professor Stellwag's work observe: "The accepted general treatment in the United Sates for diphtheria in any form is the administration of iron and nutrients, *e.g.*, beef-tea, until the patient has rallied from the depression caused by the disease. We suppose this is as applicable in diphtheritic conjunctivitis as in any other form of this blood disease."—p. 325.

Opium.

phia or chloral should be given in sufficient doses at bedtime to procure the patient sleep during the night.

Local treatment.

With regard to the *local treatment*, caustic should not be used in the first stage of the disease, for the circulation in the conjunctival vessels is already impeded by the fibrinous formation surrounding them, and caustic would simply intensify this condition; in fact, we shall in these cases, as in all other forms of conjunctivitis, do well to remember the formula already laid down on this subject. Caustic is not, as a rule, to be employed *unless a purulent discharge exists.*

Caustic in purulent stage only.

When once the purulent discharge has commenced, and the conjunctiva become red and vascular, the local treatment must be altered, and conducted upon precisely the same principles as I have described for the treatment of purulent conjunctivitis. A solution of five grains of nitrate of silver to an ounce of water should be dropped into the eye frequently, in cases where there is no ulceration of the cornea, but when ulceration has commenced, the dilute caustic pencil must be applied carefully to the tarsal conjunctiva, together with cold compresses over the lids, the eye being kept scrupulously clean. We should remember always that the discharge is not only contagious, but appears to possess irritating properties, and consequently to keep up the diseased action, if allowed to remain in contact with the eye. The general treatment will still consist in giving tincture of iron and chlorate of potash, morphia, and hot baths.

Cleanliness.

Astringent lotions.

In the third stage of the disease very little can be done, beyond ordering the patient a mild astringent lotion to be used twice a day, and bathing the eyes frequently in tepid water. We cannot prevent the formation and contraction of the cicatrices, which are unfortunately the natural consequence of the loss of tissue, following the previous destructive action of the disease.

GRANULAR CONJUNCTIVITIS.

GRANULAR CONJUNCTIVITIS, OFTEN CALLED MILITARY OPHTHALMIA.*—This is a common form of disease, particularly among the lower classes, who are exposed to malarious and other debilitating influences. It depends upon the presence of numerous small granular bodies scattered in the connective tissue of the conjunctiva, principally in the tarso-orbital fold, and sometimes in the cornea. These growths spring from the cells of the connective tissue of the part; they contain no blood-vessels or nerves, and are, therefore, utterly unlike the villi in every respect; they are, in fact, new formations, and not a mere hypertrophy of pre-existing ones, as Dr. Schmid and various other authorities hold.

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* See "Maladies des Yeux," par M. Wecker, vol. i. p. 98; "Lehrbuch der Augenheilkunde," von Stellwag v. Carion, p. 885; "L'Ophthalmie militaire à l'Académie Royale de Médecine de Belgique," par le Dr. Warlomont, *Ann. d'Oculistique* tom. xlii. 127.

Granules not enlarged villi, but new formations.

On everting the lid of a person suffering from granular conjunctivitis, it is true that we shall, in the majority of instances, find the papillæ of the conjunctiva more or less congested and enlarged, their hue varying according to the stage of the disease. In chronic cases, the epithelium covering them becomes thickened, and they are prominent and of a dusky brownish-red hue, and of course confined to the tarsal conjunctiva. On the other hand, the neoplastic growths which are characteristic of granular conjunctivitis, are most abundant on the superior tarso-orbital fold, and sometimes extend to the orbital conjunctiva where there are no villi. Frequently, however, they are so small, that we must employ a lens in order that we may clearly discern them. But whether situated in the tarsal or orbital mucous membrane, they present the same appearance of small granular masses, aptly compared to millet seeds, situated immediately beneath the conjunctiva. As the disease advances, these granular bodies may increase considerably in size, and may then be distinctly noticed scattered among the enlarged villi of the palpebral and orbital portions of the conjunctiva, and sometimes they extend to the cornea. In the more chronic forms of the malady, owing to an excessive development of intercellular material, which assumes a gelatinous character, these "granulations" sometimes attain the size and translucency of boiled tapioca grains—constituting the "frog-spawn" granulations of some pathologists.

Resemble millet-seeds, or "frog-spawn."

If we examine these granular structures with the microscope in their early stages, we find that they consist of a stroma of connective tissue, containing a number of nucleated cells with a little fluid; they

Consist of germinal matter.

subsequently undergo fatty degeneration, this is also the case in those chronic forms, where the cell elements are replaced by the gelatinous intercellular material already described. It is often difficult to draw a line of demarcation between the embryo elements of the connective tissue and the growths of granular conjunctivitis; but however similar in appearance, their properties are dissimilar, for the granular bodies, in place of becoming developed into connective tissue, degenerate into a fatty or other perishable substance, which is gradually absorbed, and the space which it has occupied contracting, small cicatrices are left to mark its former position. It is to the existence of a conglomeration of these cicatrices, and the consequent contraction of the conjunctival tissue thus induced, that the unfavourable results of this form of disease are mainly due: the cicatrices presenting a rough and uneven surface, which, by constantly rubbing against the cornea, induces irritation and subsequently vascular opacity of that important structure.

Very prone to degeneration.

Leaving cicatrices.

How far analogous to tubercle.

At the commencement of this chapter, I said that these granular bodies bore some analogy to tubercle. This is so as regards their common origin in a proliferation of the connective-tissue corpuscles, and in the unstable character of the product to which it gives rise, leading to the destruction of the normal tissue in the immediate vicinity. The analogy, however, does not extend further, and the history of granular conjunctivitis does not point to any constitutional vice allied to that of tubercle or scrofula.

Mistaken for glands.

It is quite possible to mistake the enlarged glands of the conjunctiva for the neoplastic growths of granular conjunctivitis. In all cases of irritation of the mucous membrane, the glands become swollen, and may frequently be seen beneath the conjunctiva, looking very much like the new formations which are characteristic of that affection; nor can I lay down any special rules by which to distinguish them. The enlarged glands, indeed, are still held by many pathologists to constitute the essential elements of the granular bodies noticed in the conjunctiva in this form of disease.*

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* Ophthalmic Surgery, by Dr. P. Frank: *Army Medical Department Report for* 1860. According to Prof. Stellwag, it is

Symptoms of the acute form.

Symptoms.—Granular conjunctivitis may be described under two heads, the acute and chronic; the former may be conveniently divided into three stages.

1st stage: Photophobia, pain, congestion. Granular bodies.

1. The first stage of acute granular conjunctivitis usually lasts from eight to ten days; the patient complains of intolerance of light, and supra-orbital pains; he has a sensation as if sand or grit were in the eye, and profuse lachrymation. The margins of the lid are slightly swollen, and, on everting them, we find the palpebral conjunctiva to be congested, and a number of small, white, prominent bodies, looking like millet seeds, may be noticed embedded in the mucous membrane.* This condition of the conjunctiva is most marked in the upper lid, and especially along the tarso-orbital fold. But the palpebral conjunctiva is not alone affected; the same condition extends to the mucous membrane over the globe of the eye; minute white specks of a similar nature may sometimes be seen in the cornea, with numerous small but easily defined vessels coursing over it, inducing a well-marked vascular opacity of this structure.

2nd stage: inflammatory.

2. This condition having lasted about ten days, the second or inflammatory stage of the disease commences. The conjunctiva becomes deeply congested, and in the course of a few days a purulent discharge takes place from its surface. In fact, suppurative conjunctivitis is established, so that it is almost impossible to distinguish between the second stages of purulent, diphtheritic, or acute granular conjunctivitis; for the enlarged villi, and the congested state of the mucous membrane in the latter affection, entirely conceal the neoplastic formations.

Suppuration. Cornea may suffer.

During the suppurative stage of the disease, the eyelids are often slightly swollen, and chemosis may exist; but as in purulent, so in granular conjunctivitis, our chief anxiety will be as to the condition of the cornea. Fortunately this structure is less apt to slough, or become rapidly destroyed by ulceration, in granular conjunctivitis, than it is in the purulent form of the disease. The neoplastic growths which form on

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the "spawn-like" granulations which have been more particularly confounded with hypertrophied glands.

* Dr. H. Snellen on Diseases of the Conjunctiva: *Ophth. Hosp. Reports*, vol. iv. p. 61.

the cornea might reasonably be supposed to give rise to deep-seated ulceration, but in practice this is not found to be the case: when numerous, however, they are almost certain to be followed by vascular opacity.

Sometimes prolonged,

with subacute symptoms.

In many cases the second stage of the disease is much prolonged, and is attended with less acute symptoms than those above described: this is especially the case among old or ill-nourished people. Under these circumstances the purulent stage of granular conjunctivitis is a protracted one: the patient may complain of only slight photophobia, and of little, if any, supra-orbital pain: he can open his eyes with comparative comfort, and unless the cornea is involved, can manage to see his way about. The palpebral conjunctiva, however, is intensely congested, the villi being prominent, and resembles a granulating wound, with a small quantity of pus oozing from its surface.* This state of things may last for a month or more; and although the symptoms are not very acute, they are most intractable, superficial ulceration of the cornea frequently complicating the case, and too often rendering that structure opaque; or it may be that staphyloma occurs.

A less tractable form.

In the more acute cases, the purulent stage of the disease runs its course in about fifteen days; the chemosis then subsides, the purulent discharge ceases, and the disease passes into its third stage.

3rd stage: Relapse or recovery.

3. We should then anxiously watch for the reappearance of the granular bodies: if they again become visible, the probability is that we shall have a case of chronic granular conjunctivitis to deal with. On the other hand, if the inflammatory action has been sufficiently severe to destroy the neoplastic formations, the third stage of the disease will be a comparatively simple matter.

Treatment.

Inflammation curative.

Must not be checked.

Treatment.—The treatment to be employed in acute granular conjunctivitis will necessarily vary according to the progress which the disease has made. We must bear in mind the fact, that the inflammatory action, under these circumstances, is a curative one; we may therefore with safety allow the first stage to run its course unchecked, and are likely to do more harm than good by applying astringents, and such like remedies, to the conjunctiva. If the irritation going on in the eye is excessive, the patient should be confined to a dark room, and the eyes bathed with tepid water four or five times a day. At bedtime the extract of belladonna should be smeared over the skin of the eyelids and brow, ten grains of Dover's powder being administered if the patient is restless and unable to sleep.

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* Dr. Marston on Ophthalmia: *Beale's Archives*, vol. iii. p. 194.

As I have already explained, defective sanitary arrangements appear to be a direct cause of granular conjunctivitis, and consequently, in treating this disease, we must pay great attention to the hygienic conditions under which our patient is placed. Pure air, good diet, cleanliness, and a due amount of exercise, must be carefully enjoined, otherwise the conjunctivitis is almost certain to run on into a chronic form of disease, terminating, as it too often does, in vascular opacity of the cornea.

Hygienic measures.

In the second stage of this affection, our treatment must be guided by the character of the inflammatory action going on in the conjunctiva, and more particularly by the condition of the cornea. So long as the cornea is free from ulceration, and there are no indications of destructive changes going on in it, we may with safety allow the conjunctivitis to run its course without any local application. The eyes must be kept clean, and poppy-head fomentations are often grateful to the patient, and are a means of keeping his mind employed. Tonics are generally required: soda and quinine, together with Dover's powder, may be given with advantage three or four times a day, and subsequently the chlorate of potash with the tincture of muriate of iron. I would even advise these remedies, together with a generous dietary, in cases where the second stage of the disease is pursuing an active course, and much more so when the inflammatory action is languid and weak. In the latter instance it will be well to stimulate the conjunctiva, by applying sulphate of copper to its surface once a day, until such an amount of increased action is excited as will be sufficient to destroy the neoplastic growths, which are the origin and cause of all the mischief.

Promote second stage by fomentations, tonics, generous diet, and cup. sulph.

If, however, we consider that the inflammation is more than adequate to accomplish this purpose, and that it is endangering the vitality of the cornea, we

Or control it by arg. nit. and cold.

must at once control its action by means of nitrate of silver and cold compresses. In the first instance, a five-grain solution of nitrate of silver should be dropped into the eye every second hour, and cold compresses constantly applied over the lids in the interval: it may be well at the same time to administer a purgative, and if the patient is in pain, a full dose of the hydrate of chloral at bedtime and atropine drops applied night and morning to the eye. Should the disease, in spite of this treatment, gain ground, we must smear over the chemosed conjunctiva with the dilute caustic pencil. Let it be distinctly understood, however, that this treatment will only be necessary when the cornea is in danger. Of late I have frequently employed tannin in cases of this kind with very great advantage; tannic acid being dusted into the patient's eye once or twice a day. I find a local application of tannin in this way most useful, even in the earlier stages of the disease, the cornea being hazy and vascular, with a purulent or muco-purulent discharge from the conjunctiva.

Caustic.

Tannin.

In third stage: do little.

If the second stage of the disease has done its work effectually, there will be no necessity for further interference on our part: the inflammatory action gradually subsides, and the parts return to their normal condition. A mild astringent lotion, applied to the conjunctiva twice a day, will hasten the cure, and as the lids are apt to become glued together during sleep, the dilute citrine ointment may with advantage be smeared along their edges at bedtime.

Causes.

Over-crowding.

Bad food.

Dirt.

The Causes of granular conjunctivitis may, as a general rule, be traced to influences which engender an impaired state of the nutritive functions. Among these, the overcrowding of human beings, together with filth, impure air, want of proper food, and in fact deficient sanitary arrangements in general, are doubtless the most prolific sources of this disease, and are capable not only of causing conjunctivitis in men, but also in the lower animals.

Specific infection doubtful.

It appears that the neoplastic formations, which are the primary cause of the disease, may exist as it were in a latent state for a very considerable time, but that any slight cause of irritation throws them into activity; and hence, probably, the reason why purulent matter from other sources is capable of inducing granular conjunctivitis; the truth being that the disease has been in existence prior to the inoculation of the purulent secretion, which has simply added fuel to the fire, and thrown the germinal matter of the part into a state of renewed excitation. Nevertheless, so high an authority as M. Wecker is of opinion that granular conjunctivitis is essentially a contagious disease; and there can be no doubt that in the suppurative stage, the pus from the surface of the conjunctiva may induce a purulent conjunctivitis in the eye of an otherwise healthy individual.

Prevails among the poor,

There are, probably, few people among whom granular conjunctivitis is more common than the lower orders of Irish, in Great Britain and elsewhere. The poorer classes of India, and in fact of every part of the world, are also more subject to it than their richer brethren; but local influences seem most fertile in generating the disease, and may even give it an endemic character. An instance of this kind is to be found in certain schools in Calcutta. The children in one of these schools are of different nationalities—natives, half-castes, and Europeans—but the buildings are situated in a most filthy part of the city, surrounded by open drains, and every conceivable abomination, and granular conjunctivitis is never absent from among the boys; whereas in other schools of a similar nature, but situated in a healthy locality, not a single instance of the disease is to be met with.

and in unhealthy districts.

Atropine said to cause it.

It is a remarkable fact, that a prolonged application of atropine to the surface of the conjunctiva appears to give rise to granular conjunctivitis; at any rate, one sees this form of disease arising after the long-continued instillation of atropine. Unless, however, it were positively ascertained that the neoplastic growths peculiar to this affection had no existence prior to the instillation of the alkaloid, I should not be disposed to admit the connexion of cause and effect. Many of these patients have been placed under conditions exceedingly favourable for the development of granular conjunctivitis, having probably taken no inconsiderable amount of mercury for the cure of iritis, and having at the same time been reduced by antiphlogistic measures, adopted to control the inflammation. Before, therefore, ascribing to atropine any peculiar property of developing granular conjunctivitis, I should like to watch its effects on a perfectly healthy eye; it may only act as an irritant, developing a pre-existing form of disease.

CHRONIC GRANULAR CONJUNCTIVITIS.

CHRONIC GRANULAR CONJUNCTIVITIS.—If a case of acute granular conjunctivitis has been over-treated in the first or second stages of the disease, the inflammation having been prevented from running its course, and Nature having been thus thwarted in her cure, as soon as the inflammatory action has subsided, the granular bodies reappear, and we shall then have to deal with this most obstinate affection.

Sometimes the sequel of acute.

Chronic granular conjunctivitis, however, does not always commence in this way; on the contrary, it far more frequently begins by the appearance of the neoplastic growths beneath the conjunctiva, without any antecedent irritation or inflammation. The granular bodies may be so small that we require the aid of a magnifying glass to see them. In this condition they do not necessarily give rise to any inconvenience; the patient may be unconscious of their existence, but usually complains of "sore eyes." Any slight cause, such as a disordered stomach, or over-exposure to the glare of the sun—in fact, any irritation, immediately sets up an attack of conjunctivitis; the neoplasms increase in size during these periods of disturbance, and are, indeed, the immediate cause of the hyperaction going on in the conjunctiva.*

More often primary.

May be latent, with active periods.

Individuals affected with this chronic form of disease are consequently liable to suffer from attacks of conjunctivitis, rendering them utterly unfit to carry on the ordinary duties of life. It is not uncommon to meet with soldiers suffering from granular conjunctivitis, particularly if serving in the tropics, the climate predisposing them to this affection; and their symptoms may be such as to lead one to suppose that they are malingering; their eyes look tolerably healthy, but as soon as they are put to any work, necessitating exposure to sun and dust, they get an attack of conjunctivitis. Cases of this description may at first sight appear suspicious; unfortunately, their termination, in the majority of instances, proves that they are of a most serious character, ending as they too often do in destructive changes in the cornea.†

Disabling character of the disease.

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[*] Dr. Marston on Ophthalmia: *Beale's Archives*, vol. iii. p. 201.

[†] Ophthalmic Surgery, by Dr. P. Frank: *Army Medical Reports for* 1860.

May cause hypertrophy of villi,

and opacity of cornea.

This chronic form of the disease may exist for years without inducing any great amount of hypertrophy of the villi; but sooner or later these become prominent and hard, and between them patches of white cicatricial tissue are to be seen, produced by the degenerative changes in the mucous membrane, beneath which the granular bodies existed. The uneven surface of the mucous membrane thus produced, by constantly rubbing against the cornea, often leads to vascular opacity of that structure, and it may be, to complete loss of sight.

Resumé of symptoms.

The Symptoms of chronic granular conjunctivitis have been pretty clearly indicated in the above remarks; but I may, perhaps, recapitulate them with advantage. In the early stages of the disease, the only reliable feature upon which we can depend for its identification is, the presence of the minute granular bodies beneath the conjunctiva. They give rise from time to time to attacks of conjunctivitis, the mucous membrane becoming congested, its villi more or less turgid, while the patient complains of slight pain in the eye, intolerance of light and lachrymation. After each attack of this kind, the neoplastic growths increase in size, often attaining to that of a grain of sago.

This state of things may last for a very considerable period, but sooner or later the material of the granular bodies undergoes absorption, and loss of substance thus occurring in the connective tissue of the part, the cavity closes by the formation of a cicatrix. As these minute cicatrices coalesce, patches of a dense fibrous structure appear on the surface of, or rather replace, the conjunctiva. It is seldom that the whole of the tarsal mucous membrane is thus destroyed; portions of it remain, the villi having become hypertrophied, so that the everted lid presents an uneven appearance, rough velvet-like patches rising out of a white cicatricial tissue.

The uneven surface of the conjunctiva thus produced, by constantly rubbing against the cornea, causes so much irritation in the anterior layers of the latter, that it passes into a state of vascular opacity: or it may be that entropium is produced from an incurving of the tarsal cartilage, induced by the cicatrization of the spaces occupied by the neoplastic bodies of granular conjunctivitis (*see* p. 106). As changes in the cornea advance, the sight is more or less impaired, and ultimately the patient becomes almost blind. The disease, depending as it generally does upon constitutional causes, most commonly affects both eyes.

Treatment.

Sanitary measures.

Treatment.—The remarks which I have already made, on the importance of attending to the external circumstances and hygienic conditions of patients suffering from acute granular conjunctivitis, are equally applicable to the chronic form of the disease; and unless those are carefully regulated, all other treatment will be utterly useless.

Promote suppuration by cup. sulph.

In the selection of remedies, our object must be to excite sufficient inflammation in the mucous membrane to destroy the diseased action going on in the part; and with this in view, we may smear a crystal of sulphate of copper over the conjunctiva of the upper and lower lids, every other morning, or until we have induced a considerable amount of irritation in the part, ending in suppurative conjunctivitis of a mild character.* In this way we may hope not only to cause absorption of the existing granular bodies, but also, by having at the same time improved the patient's general health, to prevent their reproduction.

Various reputed specifics.

Acetate of lead has been employed for the cure of chronic granular conjunctivitis. It is recommended that the powdered acetate of lead should be sprinkled over the surface of the diseased mucous membrane, once or twice a week. Liquor potassæ has been applied to the conjunctiva, and its efficacy is highly spoken of. I have tried many of these so-called specifics, but have never yet cured a case of granular conjunctivitis unless upon the principles above laid down, though I by no means assert that sulphate of copper is the only remedy which we can use under these circumstances. Any other substance which will excite sufficient inflammation in the conjunctiva to cause absorption of the granular bodies, will answer the purpose equally well. On the other hand, if the patient is placed in improved sanitary conditions, the disease may disappear of itself, unless the neoplastic growths have given rise to cicatricial tissue replacing the healthy conjunctiva. In combination with general treatment of this description, in chronic cases of granular conjunctivitis, complicated as they always are with more or less haziness of the cornea, tannic acid dusted into the affected eye once or twice a day affords the patient a better hope of relief than any treatment I know of. I must refer the reader to the section on diseases and opacity of the cornea for further information as to the treatment of these complications.

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* M. Warlomont having tested a number of medicinal agents with a view to find a substitute for inoculation, is in favour of sulphate of copper.—*Ophthalmic Review,* vol. i. p. 186.

Prevent contagious diffusion.

I need hardly say that soldiers, suffering from this form of conjunctivitis in the tropics, should be sent to Europe. As a general rule, they are an actual encumbrance to the service, being quite useless as effective members of their regiments; while, at any time, active changes may be set up, and a purulent discharge established, capable of propagating suppurative conjunctivitis by contagion, and they may thus become a source of widespread mischief to their comrades.

Researches of Belgian Academy on military ophthalmia.

The following conclusions regarding military ophthalmia (granular conjunctivitis) have been arrived at by M. Warlomont, from an analysis of the lengthy discussion on this subject by the Royal Medical Academy of Belgium:—

I. Military Ophthalmia, also called contagious ophthalmia, granulous ophthalmia, &c., is an affection essentially transmissible, and subject to easy and frequent relapses. Those who have been affected by it are never sure of a perfect cure.

Propagation of military ophthalmia.

II. If it be true, as some state, that it can arise spontaneously in civil populations, it is as surely established, on the other hand, that in all the countries of Europe, where its presence has been assured, it has always commenced in the army, and spread itself from them among other classes of the population.

III. In Belgium, especially, it has been proved that before 1834 it affected the army almost exclusively. It was only after this period, and dating from the disbanding of those affected by granulations, and their return to their homes—a measure ordered by the Minister of War, on the proposition of the Sanitary Inspector-General of the Army, and sanctioned by the

Commission of Inquiry and by Professor Jünken of Berlin—that its extension began among the civil population.

IV. The isolation of individuals affected with military ophthalmia in all its stages is imperatively demanded by the contagious character of the affection. Beyond this prophylactic measure, it is not possible to retard or extirpate the disease. To send back affected patients to their homes is, therefore, a dangerous and irrational proceeding.

V. Individuals who have had this ophthalmia during their service, may be attacked afresh with it in their homes, without having been again exposed to the producing cause, and though they may have borne no traces of the disease at the time of their discharge. These relapses may take place at periods more or less distant, and science, possessing no criterion by means of which the limits of the connexion may be fixed, the disorders which are the consequence of it may be brought forward by those who have suffered from them, and urged as a claim to the assistance of the State, whatever may be the interval which has intervened between the first and following attacks.*

PUSTULAR CONJUNCTIVITIS.

PUSTULAR CONJUNCTIVITIS.†—Under this head I shall include the "conjunctivitis phlyctenulosa" and "pustulosa," the "scrofulous corneitis" or "herpes of the conjunctiva and cornea" of some authors.

Two forms:

Conjunctival and corneal.

It is advisable, however, to describe pustular conjunctivitis under two heads, according to the position of the pustules or herpetic spots; in many instances they are confined to the orbital mucous membrane, and the conjunctivitis is then a very simple matter, but if the pustules extend to the cornea, it becomes one of the most distressing affections from which a patient can suffer. In some cases the pustules invade both the cornea and conjunctiva at once, or they may surround the cornea like a row of beads; at other times they are situated partly on the cornea and partly on the conjunctiva.

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* L'Ophthalmie militaire à l'Académie Royale de Médecine de Belgique, par M. le Dr. Warlomont, extrait des *Annales d'Oculistique*, tom. xlii. p. 126.

† "Maladies des Yeux," par M. Wecker, vol. i. p. 139.

1. With regard to that form of the disease in which the pustules are confined to the conjunctiva. In these cases they rarely exceed two or three in number, but are apt to occur in succession one after the other, and consequently worry the patient a good deal. Each so-called pustule consists at first, either of a simple elevation of the epithelium by a collection of serum beneath it, forming a minute vesicle not larger than a pin's head, or of an equally minute, whitish, nodular mass or pimple, on the summit of which a similar vesicle is quickly developed. These little bodies are situated on a patch of congested conjunctiva, while the remainder of the mucous membrane may present a perfectly healthy appearance. (Fig. 1, Plate III.) If several pustules co-exist on the conjunctiva of the same eye, a large portion, or even the whole membrane, may look red and inflamed; the pustules, however, being raised above the surface of the conjunctiva, and of a whitish-yellow colour, are always sufficiently apparent against the red ground. Under these circumstances, as I have before remarked, they are usually situated near the margin of the cornea, and sometimes extend over it, being partly on the conjunctiva and partly on the cornea.

First form.

"Pustules" few and isolated.

Vesicular summits.

Congested base.

These little pustules contain at first a clear serous fluid; this quickly undergoes a change, becoming yellowish and opaque, and they then present the appearance of so-called lymph vesicles. The contents may become absorbed in the course of eight or ten days; or the epithelium giving way, the fluid beneath it escapes, and a superficial ulcer remains, which in the majority of instances is speedily healed by fresh layers of epithelial cells; the congestion of the conjunctiva then disappears, and the parts return to their normal condition.*

May dry up or burst.

Symptoms.—The subjective symptoms to which this form of pustular conjunctivitis gives rise are usually unimportant, the patient complaining of a sensation of grit or sand in the eye, and of slight pain when the eyeball is turned in the opposite direction to the band of congested conjunctival vessels. After using the eye for a time, it begins to ache and water slightly. Unless

Sensation of sand.

Eye aches and waters.

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* "Pathology of the Human Eye." Dalrymple, Plate XIII. description.

the pustules are situated on the cornea, the patient seldom suffers from intolerance of light, but comes to us with his eyes wide open, complaining of the above symptoms; he will probably add that his eyelids stick together during sleep. On examining the eye, one or more pustules may be seen on or near the margin of the cornea, the conjunctiva surrounding them being somewhat congested; but with this exception, the eye appears perfectly healthy.

Treatment. Dusting with calomel.

Treatment.—I know of no treatment so efficacious in this form of pustular conjunctivitis, as dusting over the vesicles and congested portion of the conjunctiva with calomel, once a day. The calomel may be most conveniently applied with a camel's-hair pencil, and the eyelids immediately closed and kept shut for a few minutes. This application causes the patient a little pain and momentary irritation, but it certainly cures the conjunctivitis with remarkable rapidity. In addition to the calomel, the edges of the lids should be smeared with the dilute oxide of mercury ointment (one part to three of cacao butter) every night before going to bed. Some surgeons recommend a weak solution of acetate of lead or zinc to be dropped into the eye two or three times a day. But independently of treatment, the tendency of the disease is to get well of itself in the course of a few days, unless the patient be in a low and weak state of health, when the pustules are apt to appear in succession, and cause him considerable inconvenience; nor will they disappear until the general health has been improved by suitable means.*

Ung. hyd. ox.

Improve general health.

2. Corneal form.

2. In the second class of cases of pustular conjunctivitis, or, as it has been styled, herpes of the cornea, in contradistinction to that of the conjunctiva, both eyes are usually affected; the disease is most commonly met with among children from six to twelve years of age. This affection is sometimes described as scrofulous keratitis.†

"Scrofulous keratitis."

On examining the cornea, which may be a matter of difficulty, on account of the spasmodic closure of the lids and intolerance of light which attend the affection

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* Lectures on Diseases of the Eye, by Mr. Critchett: *Lancet*, vol. i., 1854, p. 509.

† Dixon "On Diseases of the Eye," p. 95, 3rd edition.

—we shall notice several small white specks on its surface, consisting of vesicles or pustules precisely similar to those already described as occurring on the conjunctiva; they also run the same course, either their contents become absorbed, or the epithelium covering them bursts and gives exit to a little serous fluid. The pustules are confined, in great measure, to the superficial layers of the cornea, but the abraded surface sometimes takes a considerable time to heal, and is apt to degenerate into an unhealthy ulcer, which may involve the deeper layers.* There is a marked disposition for a succession of these pustules to form, sometimes for months together, rendering the complaint both a distressing one to the patient, and difficult to cure.

Pustules on cornea.

May leave ulcers.

In well-marked cases the cornea is hazy, spots of opacity, corresponding to the pustules, being scattered over its surface; vessels may also be seen meandering over it from the conjunctival border towards the pustules. Permanent vascularity of the cornea, however, is not a common consequence of this disease. The vessels of the conjunctiva, as a general rule, become uniformly, though not deeply congested; the subconjunctival tissue is also involved, and its characteristic pinkish zone, surrounding the circumference of the cornea, is often to be seen.

Cornea hazy.

Conjunctival and scleral congestion.

The skin about the inner angles of the eyes is very apt to become excoriated, from the patient constantly pressing his hands against his eyelids to exclude the light, and from the perpetual flow of tears over the part. This excoriated state of the inner angle of the eye and lower lid often adds much to the patient's troubles; moreover, in many cases, the disease is associated with eczematous or herpetic sores about the nostrils, lips, or cheeks, and it may be with an enlargement of the glands of the neck.

Excoriation and sores of face.

But perhaps the most characteristic feature of this form of the disease are the nervous phenomena which attend it—the intense intolerance of light, and spasm of the lids. There may be also considerable ciliary pain, but this is by no means a constant symptom. The photophobia and blepharospasm are intimately

Photophobia and blepharospasm.

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* "Maladies des Yeux," par M. Wecker, vol. i. p. 141.

associated with each other, the former being referrible to hyperæsthesia of the retina or optic nerve, by which a painful sense of dazzling is produced by even a feeble light; and the latter to a morbid reflex action, excited by irritation of the ciliary nerves distributed to the cornea, of the optic nerve, or both, and reflected through the portio dura, which is the motor nerve of the orbicularis. There can be no doubt that the impression of light on the retina plays a most important part in exciting this spasm, for it is greatly lessened if the patient be removed into a dark room, and he may even succeed in opening his eyes; the relaxation, however, is by no means complete, and it therefore seems reasonable to infer that both the optic and fifth nerves co-operate in its production, just as in the familiar instance of sneezing, which though generally excited through the fifth nerve, may also in this affection of the cornea be determined by a dazzling light.

Nature of the nervous phenomena.

It is generally possible to diagnose a case of this form of conjunctivitis, from the appearance and gesture of the patient, without even examining his eyes; he comes to us with his eyelids firmly closed, his head bent down, and a handkerchief or both hands pressed against his eyes, so as to exclude every particle of light from reaching the retina. If we attempt to force open the eyelids, a gush of tears escapes from them, and the eyeballs are involuntarily turned upwards, the patient making a desperate effort to close the lids, and sometimes sneezing violently.

Physiognomy diagnostic.

The prominent features, therefore, of this form of conjunctivitis, are the hazy state of the cornea and the great intolerance of light from which the patient suffers; he may complain of slight pain in the eye, but this is by no means a constant symptom of the disease.

This affection has generally a tendency to remissions towards evening. A patient who has probably remained during the greater part of the day hid away in the darkest corner of the house, and often with his face buried in a soft pillow, so as to exclude every ray of light from his eyes, suddenly brightens up towards evening, and is ready to play about with his companions.

Evening remissions.

Treatment.

Treatment.—Herpes of the cornea is usually a very

Pure air, good food, cod-liver oil.

Iron.

Quinia.

Arsenic.

persistent and troublesome affection to cure. Our treatment must be mainly directed to the improvement of the patient's general health. Cod-liver oil and iodide of iron, together with nourishing food, cleanliness, and fresh air, are without doubt the class of remedial agents upon which most reliance can be placed. In place of giving iron, we may commence our treatment by administering a few grains of quinine combined with carbonate of soda twice a day; these drugs may be continued with advantage, together with iodide of iron. Arsenic is especially useful in cases where the disease is accompanied with eczema or other affections of the skin covering the patient's face; in instances of this description, to cure the disease of the skin is to cure the affection of the eyes. Arsenic is administered, I think, most advantageously in the form of the liquor arsenicalis, to be taken freely diluted in water, after food. The dose must, of course, vary with the age of the patient; but for an adult I generally order six minims, to be increased to ten, three times a day, until the affection of the skin and eyes begins to improve, or until the characteristic effects of the drug have manifested themselves in the patient.

Counter-irritation.

Counter-irritation, by means of tincture of iodine painted over the skin of the lids every evening, or a succession of small blisters, or an issue opened in the skin of the temple, are useful adjuncts to the foregoing treatment.

Atropine.

I order a strong solution of atropine to be dropped into the eye twice a day; it relieves the intense photophobia, and has generally a very beneficial effect.

Belladonna.

Calomel.

It sometimes happens that atropine irritates the eye, in which case the extract of belladonna, containing a grain of atropine to the half ounce, may be rubbed over the eyebrows twice a day. But the pupils must be widely dilated before we cease the application of this drug in or over the eye, and it is frequently necessary to keep up its action for ten or fifteen days. It generally happens that the patient experiences great relief after his pupils have become fully dilated by means of atropine or belladonna, used as above directed. As soon as the irritation has subsided, calomel should be dusted over the surface of the patient's cornea once a day, until the haziness and vascularity covering it have disappeared. I think calomel applied in this way is preferable to the red precipitate ointment, but in the case of irritable nervous children the latter application may perhaps be more easily managed. The ointment should be applied once a day; the lower lid being everted, a small piece of the ointment is to be deposited on its surface, and the eye then kept closed for a few minutes, the lid may then be again everted and the remains of the ointment wiped from its surface by means of a bit of soft rag.

Dark room by day. **Exercise in dusk;** **Or pad and bandage.**

The patient must be kept in a dark room during the daytime, but exercise should be taken morning and evening, and in fact every means employed to improve his general health. If he can wear a compress and bandage over his eyes, without exciting increased uneasiness, it is advisable for him to do so, as the light is thus shut out from the retina, and the patient is moreover by aid of the compress frequently enabled to move about, and enjoy the fresh air and society of his friends, in place of the solitude of a dark room. With children it is difficult to keep the pad and bandage constantly applied, but, fortunately, their natural buoyancy of spirits overcomes the depressing influence of darkness, and they will bear confinement far better than adults.

Applications to the skin.

When abrasion or ulceration of the skin at the corner of the eye exists, the part should be smeared over with the tannate of glycerine, or one part of carbolic acid to forty of cod-liver oil; but above all things avoid washing the part with water, and keep it protected from air and dust, the skin being smeared over with one of the above preparations, or with the benzoated oxide of zinc ointment, and then covered with a light bandage.

Causes.

Causes.—The form of pustular conjunctivitis, which attacks the orbital conjunctiva alone, sometimes occurs without any apparent cause; but in the majority of cases the health of the patient will be found to be somewhat impaired. When the cornea is the seat of the disease people say it is frequently associated with a scrofulous diathesis—so much so, that this form of pustular conjunctivitis has been described as scrofulous

Impaired health.

keratitis.* In very many instances, however, no trace of scrofula is to be detected; nevertheless, I freely admit, that if the word unhealthy is substituted for scrofulous, I coincide in the above opinion, and there can be no doubt that scanty and unwholesome food, want of light and air, and defective hygienic conditions generally, are most influential in developing this disease among the children of the poor. But we must bear in mind the fact that herpes of the cornea may be induced by various sources of irritation applied to the ciliary nerves, either directly or through other branches of the fifth nerve. We may thus explain the occurrence of the disease in instances of eczema or other cutaneous affections of the cheeks, or nasal mucous membrane.

Scrofula doubtful.

EXANTHEMATOUS CONJUNCTIVITIS.

In measles and scarlet-fever no special treatment.

EXANTHEMATOUS CONJUNCTIVITIS.—In concluding the subject of conjunctivitis, I may make a few remarks upon the exanthematous form of the disease. In the case of measles and scarlet fever, very little need be said, for in the majority of instances the conjunctivitis disappears as the disease recedes, and no special treatment is required. Should any complication occur, such as ulceration of the cornea, a reference may be made to the appropriate heading in the following chapter, and it will be unnecessary to discuss the subject here. As a general rule, poppy-head fomentations will allay the irritation which sometimes exists, and any transient intolerance of light which may occur is a symptom of no consequence, and can only necessitate the patient's being kept in a dark room for a few days. Astringents, such as alum and sulphate of zinc, do more harm than good, as a general rule, if applied to the conjunctiva; in fact, a soothing plan of treatment must be employed, and as the primary disease leaves the system, the conjunctiva will rapidly return to its normal condition.

In variola.

In the case of variola, especially in parts of the world to which the blessings conferred by vaccination have not as yet extended, the destruction done to the organs of vision by this disease is very terrible. Probably more natives of India are rendered blind from this than any other cause.

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* The unhealthy sores about the face and ears, and the consequent enlargement of the glands of the neck, which often accompany this complaint, have no doubt mainly suggested the designation.

Ulceration of cornea.

It does not appear that pustules form on the cornea during the eruptive stages of the disease;* but ulceration and rapid destruction of its tissue are very apt to occur during the stage of secondary fever. This is an important fact in a practical point of view, because it hence appears less necessary to attend to the state of the eyes when the lids are intensely swollen, as they usually are in the irruptive stage of the affection, than subsequently, when the swelling has gone down, and the patient is left in a weak and exhausted condition. The eyes must then be carefully looked to, and any haziness or opacity of the cornea should be a source of anxiety to the practitioner, for it is extraordinary how rapidly destructive changes progress under these circumstances: the corneal tissue is often broken down and destroyed in the course of a few days, prolapse of the iris following, and too often the complete destruction of the eye.

During secondary fever.

Often very destructive.

Treatment.

Treatment.—As a general rule, we must trust more to a tonic plan of treatment than to local means. The patient's strength should be supported by every device at our command; his eyes must be kept most scrupulously clean, and the margin of the lids smeared over with sweet oil or fresh glycerine at bedtime, to prevent their sticking together. A strong solution of atropine should be dropped into the eye every morning, so as to keep the pupil well dilated, especially if the cornea is already ulcerated. Should the destructive process appear to be advancing in spite of these precautions, we must puncture the cornea and allow the aqueous to escape, so as to lessen the tension of the eyeball; and in some cases an iridectomy, either with or without extraction of the lens, must be resorted to, as will be explained in the next chapter under the head of ulceration of the cornea.

Support strength.

Cleanliness.

Atropine.

Evacuation of aqueous.

XEROPHTHALMIA.

XEROPHTHALMIA is a very uncommon form of disease, in which the glands of the conjunctiva lose their function, and cease to secrete sufficient fluid to lubricate the surface of the mucous membrane.

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* Article by Mr. Marson, Reynolds' "System of Medicine," vol. i. p. 444.

The conjunctiva acquires a shrivelled, skin-like (cuticular) character; the cornea loses its transparency, and vision thus becomes seriously impaired. Xerophthalmia usually arises from long-continued irritation; such as that produced by granular conjunctivitis, or from the action of foreign substances which have destroyed the surface of the mucous membrane. It may be relieved by the application of glycerine or castor-oil to the surface of the eye, but we know of no means by which it can be cured.*

Dry conjunctiva.

Castor-oil a palliative.

INJURIES OF THE CONJUNCTIVA.

FOREIGN BODIES ON THE CONJUNCTIVA.—The form of injury most commonly presented to our notice is the superficial one, produced by a foreign body lodged on the surface of the mucous membrane. As a general rule, small particles of dust, or similar substances, which happen to find their way into the eye, cause a considerable amount of irritation of the peripheral branches of the fifth nerve, and by reflex action, a profuse flow of tears from the lachrymal gland, and this washes the offending particle out of the eye, or towards the caruncle, upon which it may often be found deposited.

FOREIGN BODIES.

Natural removal by tears,

But this effort of Nature is frequently thwarted by the patient, who, after a foreign body has found its way into his eye, should seize the cilia of the lid, behind which it has lodged, and gently draw the lid forward from the globe of the eye, thus facilitating the action of the tears in washing away the offending particle. In place of this, the majority of people commence rubbing away at the lids, and in their frantic efforts to remove the cause of their suffering, drive it more firmly into the conjunctiva.

often thwarted by patient.

Should the foreign body happen to be situated on a part of the mucous membrane of the lid corresponding to the cornea, as it rubs against the latter structure during the movements of the lids, it excites the most intense irritation and pain. That it is from contact with the cornea that these distressing symptoms are

Pain from contact with cornea.

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* "Handy-Book of Ophthalmic Surgery," by J. Z. Laurence and R. C. Moon, p. 58.

principally induced, there can be no doubt, for if the particle be lodged on any part of the mucous membrane which is not so situated—as, for instance, in the oculo-palpebral fold—it excites comparatively little irritation. So much is this the case, that patients now and then come under our notice, suffering from conjunctivitis depending upon the presence of a foreign body, which may have been lodged on the conjunctiva for some time, while its existence has never been suspected.*

Insects.

Insects not uncommonly find their way into the eye, and may excite the most intense inflammation by their acrid secretions. The flying bug of this country (India) is a good example; it exudes some substance from its body of a highly irritating character, and it is not uncommon to meet with instances of severe conjunctivitis which have been excited in this way. Barring cases of this kind, insects, as a general rule, do not produce more irritation than other foreign bodies lodged on the conjunctiva.

LIME AND OTHER CAUSTICS.

QUICKLIME AND OTHER CAUSTIC SUBSTANCES, by their chemical action on the tissues, destroy the vitality of the mucous membrane, and a slough forming, the part can only heal by means of a cicatrix. The cicatricial tissue, in contracting, may cause entropium; or union of the palpebral and orbital surfaces of the mucous membrane may occur (symblepharon).

From time to time we meet with cases in which molten lead has run into the eye, and it is sometimes surprising to observe, how effectually the stratum of steam formed over the eye by the heated substance will protect the part from injury. But should the destructive action of the molten lead extend to the connective tissue of the conjunctiva, a slough forms, and the wound healing gives rise to a cicatrix, or to symblepharon.†

Cause cicatrices and adhesions.

The effects of lime may be confined to the superficial layers of the conjunctiva, but this is seldom the case, and it generally induces disorganization of the parts with which it comes in contact. One of the first things commonly noticed on examining the eye of a patient after lime has fallen into it, is, that the cornea has become opaque in those parts which have come in contact with the lime. This haziness may subsequently clear off, but the damage done more frequently leads to necrosis of the cornea, and destruction of the eye.

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* "Injuries of the Eye, Orbit, and Eyelids," by Mr. G. Lawson, p. 3.

† See case reported by Mr. Hutchinson, *Ophth. Reports*, vol. i. p. 217.

LACERATED WOUNDS.

LACERATED WOUNDS of the conjunctiva are occasionally met with, the mucous membrane being torn open to a greater or less extent by some sharp-pointed instrument. A considerable amount of ecchymosis generally takes place in such cases, causing the patient much anxiety; but otherwise wounds of the kind are not generally of an urgent nature, and usually heal very rapidly.

Heal readily.

Treatment.

Treatment of Conjunctival Injuries.—I need hardly remark that if the injury arises from the presence of a foreign body, the offending substance must be at once removed, whether it be an insect, lime, or any other matter.

Search for foreign body, and remove it.

I have already described the method of everting the upper lid, p. 19; it is often necessary carefully to explore the whole surface of the mucous membrane, together with the tarso-orbital and semilunar folds, before we can discover the object of our search; and to add to our difficulty, the conjunctiva round the foreign body often becomes swollen and chemosed, covering in the offending substance, and completely hiding it unless most carefully sought for. When found, there is usually no difficulty in dislodging it from the surface of the conjunctiva by the help of a needle or spud; but if very firmly impacted, it may be necessary, with a pair of scissors, to snip off the little fold of conjunctiva in which the foreign body is embedded. The eye should subsequently be closed with a light pad and bandage for a day or two.

In case of lime give chloroform.

In instances where lime has fallen into the eye, the pain it causes is often so great, that it is necessary to put the patient under the influence of chloroform before a proper examination can be made. The particles of lime must then be carefully removed, being picked off the conjunctiva with a small spatula or needle. The eye should subsequently be well syringed with warm water, the stream being especially directed beneath the upper eyelid, so as to wash away

Syringe the surface.

every particle of the lime.* Syringing the surface of the eye in this way is equally useful if dust or powder has fallen into it, which might otherwise be difficult to remove.

Management of the inflammation.

After accidents of this kind, severe inflammation of the conjunctiva and deeper structures of the eye may take place, and if so must be treated upon the principles already laid down for such cases. Hot poppy-head fomentations, a few leeches, and the administration of opium, will probably form a chief portion of our treatment. Nor must we forget that as the iris is likely to become involved, a strong solution of atropine should be dropped into the eye so as to dilate the pupil. If there is much pain in the eye, a subcutaneous injection of one-fourth of a grain of morphia over the eyebrow will afford great relief to the patient.

Prevention of adhesions.

When a portion of the conjunctiva has been destroyed, either from the contact of a substance such as lime, or from a burn, our first care will be to prevent, if possible, the injured orbital and tarsal surfaces of the conjunctiva from uniting; a most difficult task to accomplish, in which too frequently our best efforts are thwarted, and an intimate union between the surfaces of the mucous membrane occurs.

Mechanical expedients,

rarely successful.

Many years ago Mr. Tyrrell inserted metallic plates between the opposed surfaces in cases of this kind, in order to prevent their union, but spoke discouragingly of the result.† More recently it has been proposed that a patient, under these circumstances, should have an artificial eye with a hole in its centre corresponding to the cornea, applied over the eye, which by fitting closely on the globe, and being constantly worn, might have the effect of preventing union between the wounded orbital and palpebral surfaces of the conjunctiva. The proposal seemed reasonable, but unfortunately it is found that union of the wounded surfaces commences sooner or later at the lower part, and this gradually raises and displaces the artificial eye.

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* "Wounds and Injuries of the Eye," by W. White Cooper, p. 277. The eye douche of vulcanized india-rubber, with a rose jet, is recommended for this purpose.

† See article by Mr. Wordsworth, *Ophthalmic Hospital Reports*, vol. iii. p. 216.

Moreover it is seldom under these circumstances that we can get a patient to retain an artificial eye in contact with the eyeball; it generally excites such unbearable irritation in the part.

Lint dressing.

In slight cases we should endeavour to keep the lids separated from the globe of the eye by means of a piece of lint, soaked in glycerine or oil and laid between the eyeball and eyelid; but, as I have before remarked, our best efforts are generally inadequate to prevent union between the wounded surfaces of the conjunctiva.

Lacerated wounds of the mucous membrane, with few exceptions, heal very rapidly, and no further treatment is necessary than keeping the lids closed with a pad and bandage for a few days. It is well, if possible, to bring the edges of the wound together with fine silk sutures.

SYMBLEPHARON.

Adhesion between the lids and globe.

SYMBLEPHARON, or adhesion between the palpebral and orbital portions of the conjunctiva, may be either complete or incomplete; in the latter, one or more bands of cicatricial tissue unite the opposed surfaces, and in complete symblepharon, either the upper or lower eyelid, in one or both eyes, is closely adherent by the whole extent of its surface to the orbital conjunctiva.

Follows various lesions.

This state of things may be caused by any accident which sets up destructive changes in the opposing surfaces of the conjunctiva—as, for instance, diphtheritic conjunctivitis, ulceration, injuries, or burns involving the mucous membrane; but the contact of quicklime with the eye is probably the most frequent cause of symblepharon.

Provided the adhesions do not involve the cornea, the patient's sight is unaffected by symblepharon; but under any circumstances, he experiences more or less inconvenience from the constrained movements of the eyeball, consequent on the adhesions, and in many instances from epiphora, the puncta being more or less displaced.

Treatment.

If complete, operations fail.

Treatment.—As a general rule partial symblepharon only should be operated on. In the complete form, unless the cornea is involved, it may be inferred from what has been already said, that we can seldom expect to improve the patient's condition by means of an operation. A variety of contrivances have been suggested to keep the surfaces of the conjunctival wound apart, but they have, as a rule, failed most signally.

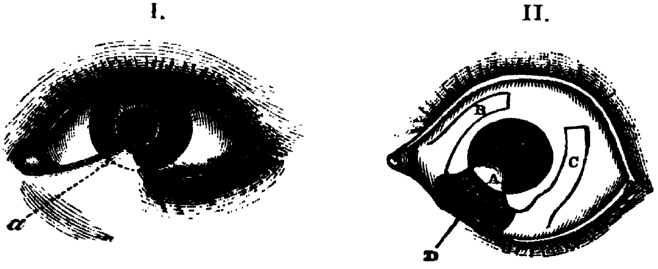
If partial, divide bands.

With regard to partial symblepharon, the bands of adhesion may, in slight cases, be simply divided, and the extremities of the fræna separated by everting the lid frequently, say every hour during the day, and once or twice in the night, until the surface of the conjunctival wound has healed. In more extensive partial symblepharon, the bands of adhesion should be divided first of all close to the globe of the eye, the edges of the wound in the orbital conjunctiva having then been united with fine sutures should be allowed to heal. We may afterwards proceed to treat the palpebral extremities of the fræna in the same way. The lids should be frequently everted, so as, if possible, to prevent the symblepharon from again forming.

Teale's operation.

Mr. Teale recommends the following proceeding in instances of partial symblepharon, and I have on several occasions found this operation useful in cases of this kind. Mr. Teale describes his mode of operating as follows:—Having first made an incision through the adherent lid, in a line corresponding to the *margin* of the concealed cornea (see Fig. 20* I. *a*), I dissected the lid from the eyeball until the globe moved as freely as if there had been no unnatural adhesions. Thus the apex of the symblepharon (Fig. II. A) being part of the skin of the lid, was left adherent to the cornea.

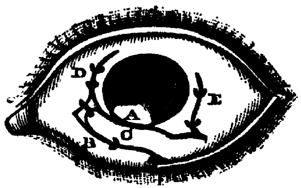
FIG. 20*.



I. II.

In the next place two flaps of conjunctiva were formed, one from the surface of the globe near the inner extremity of the raw surface, the other from the surface of the globe near its outer extremity. I first marked out with a Beer's knife a flap of conjunctiva (B, Fig. II.), nearly a quarter of an inch in breadth and two-thirds of an inch in length, with its base at the sound conjunctiva, bounding the inner extremity of the exposed raw surface, and its apex passing towards the upper surface of the eyeball. The flap was then carefully dissected from the globe until it was so far at liberty as to stretch across the chasm without great tension, care being taken to leave a sufficient thickness of tissue near its base. A second flap was then made on the outside of the eyeball in the same manner. In making the flaps, conjunctiva alone was taken, the subconjunctival fascia not being included. The two flaps thus made were then adjusted in their new situation (see Fig. III.). The inner flap, B, was made to stretch across the raw surface of the eyelid, being fixed by the apex to the healthy conjunctiva at the outer edge of the wound. The outer flap, C, was fixed across the raw surface of the eyeball, its apex being stitched to the conjunctiva, near the base of the inner flap. Thus the two flaps were dovetailed into the wound. The flaps having been adjusted in their new position, their vitality was further provided for by incising the conjunctiva near their base, in any direction in which there seemed to be undue tension, and by stitching together the margins of the gap whence the transplanted conjunctiva had been taken, (*e.g.*,) D, E, Fig. III. One or two other sutures were inserted, with a view to prevent doubling in of the edges of the transplanted conjunctiva.*

III.



HYPERTROPHY AND ATROPHY.

PTERYGIUM. Wing-like hypertrophy.

PTERYGIUM consists of an hypertrophy of a portion of the orbital conjunctiva and subconjunctival tissue, which is often very vascular, and has usually a triangular shape, the base of the figure being towards the semilunar fold, and the apex extending to the cornea (Fig. 21). But it by no means follows that a pterygium always spreads from the inner side of the eye;

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* *Ophthalmic Hospital Reports*, iii. p. 253.

it may exist on the temporal, upper, or lower portion of the conjunctiva, but its apex is usually turned towards, or rests on the cornea, in some cases extending over it so far as to interfere with the passage of light through the pupil. In other cases a pterygium, except that it is unsightly, gives the patient no inconvenience.

Common in India.

From ulcers or dust.

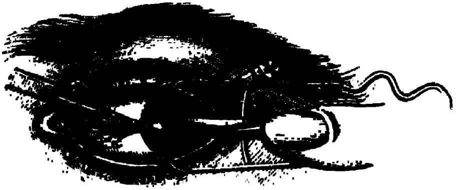
This form of hypertrophy of the conjunctiva is very common among the natives of India, and in the majority of cases begins in superficial ulceration of the margin of the cornea, the pterygium commencing at this spot, and gradually extending itself outwards. In other instances it appears to depend upon the irritation caused by small particles of sand and dust, which, finding their way into the eye, are washed by the tears along the palpebral sulcus to the lacus lachrymalis; the constant irritation thus produced leads to hypertrophy of the conjunctiva at the inner corner of the eye.

Treatment.

Dissect away the growth.

Treatment.—The pterygium must be dissected away from the surface of the globe. The patient having been placed under the influence of ether, his eyelids are to be separated with a stop speculum, the thickened conjunctiva is seized with a pair of forceps, or a hook, about midway between the semilunar fold and the cornea, and a cataract knife or a pair of scissors (Fig. 21) being passed beneath the conjunctival growth, it is to be thoroughly dissected away from the sclerotic as far outwards as the semilunar fold, and also from the front of the cornea, should it have extended so far; the edges of the wound in the conjunctiva should then be brought together with one or two fine silk sutures. The success of the operation depends upon our removing the whole of the hypertrophied conjunctiva. After the operation cold-water dressing may be applied to the eye, until the wound of the conjunctiva has

FIG. 21.



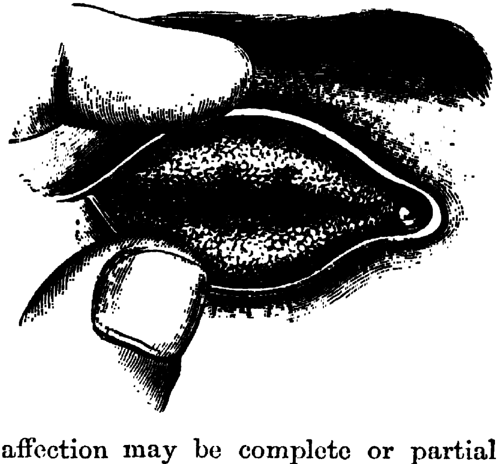
healed. I have performed this operation for years past in numerous cases, and never saw it followed by a dense cicatrix, much less by one which drew the eye inwards, or limited its movement in any way.

Hypertrophy. **From inflammation.**

HYPERTROPHY OF THE CONJUNCTIVA is by no means of uncommon occurrence, following suppurative or other forms of conjunctivitis. The villous structure is principally involved, and the disease is therefore generally confined to the palpebral portion. Hypertrophy of the conjunctiva is frequently erroneously described as "granular conjunctivitis," or "granular lids," the enlarged villi presenting much the appearance of the granulations of a wound* (Fig. 22). The distinction between them has already been sufficiently insisted on in an earlier part of this chapter.

Villi chiefly enlarged.

FIG. 22.



This affection may be complete or partial, one or both lids, or only a portion of either of them, being involved.

On everting the eyelids, the mucous membrane appears red and rough, presenting in fact very much the appearance of a healthy granulating sore. The uneven surface of the conjunctiva, by rubbing against the cornea, in the course of time may render it opaque and

May cause opacity of cornea.

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* "Lehrbuch der praktischen Augenheilkunde," von K. Stellwag von Carion, p. 404.

vascular; but this hypertrophy of the conjunctiva is by no means so frequent a cause of vascular opacity of the cornea as granular conjunctivitis.

Treatment.

Improve the general health.

Treatment.—In the majority of instances of hypertrophy of the conjunctiva, the state of the patient's general health will be found to be at fault, and this we must improve by tonics, or other appropriate treatment, before we can hope for any amendment in the condition of the conjunctiva.

Scarification.

Tannic acid.

Chromic acid.

An almost incredible variety of local applications have been advocated from time to time for the cure of this affection. I recommend the following plan of treatment in severe cases:—The lids should be everted as shown in Fig. 22, and the hypertrophied conjunctiva may then be scarified, the bleeding being encouraged by wiping away the clots of blood, as they form, with warm water. When the bleeding has ceased, the mucous membrane should be dried with a soft cotton rag, and a strong solution of tannic acid may be painted over the part. This application should be used about twice a week, and if it does not succeed in reducing the enlarged villi, we may employ a solution of chromic acid in the same way.

Acetate of lead.

In less severe cases, the lids having been everted, the conjunctiva may be sprinkled over with powdered acetate of lead; or sulphate of copper may be applied to the surface of the hypertrophied tissue; a crystal of the latter salt lightly drawn over the surface of the conjunctiva twice or three times a week for a month, may prove advantageous. Tannic acid dusted into the patient's eyes every morning, has been a favourite local application with many surgeons, and is no doubt often of marked service in cases of this kind.

ATROPHY.

From conjunctivitis.

ATROPHY OF THE CONJUNCTIVA most commonly results from diphtheritic or granular conjunctivitis; chemical agents, by destroying the tissue, may induce similar results.

Forms white patches.

Pannus and entropium.

The atrophied structure presents a white and shining appearance, and as a general rule occurs in patches. In consequence of the naturally smooth and soft mucous membrane being replaced by the atrophied tissue, irritation of the cornea, and ultimately vascular opacity of that most important structure, are frequently produced. The atrophied conjunctiva is further apt to contract, so that the lids are shortened from side to side, and their margins incurved (entropium).

No cure.

We are of course utterly unable to restore the atrophied mucous membrane, but fortunately we may prevent or correct its baneful effects, by the means I have described under the heads of entropium and vascular opacity of the cornea.

RELAXED CONJUNCTIVA. In the aged.

RELAXATION OF THE CONJUNCTIVA is seldom met with unless among old people, and then it occurs from the absorption of the adipose tissue of the orbit, and the sinking inwards of the eyeball, the conjunctiva being left hanging loosely from its attachments over the globe. The folds thus formed are most marked towards the inner angle of the eye.

Use astringents.

Astringent lotions usually constrict the conjunctiva sufficiently to overcome any inconvenience the patient may experience from this condition; but if these fail, a portion of the superfluous membrane must be snipped off; the edges of the wound unite and effectually remedy the complaint.

ŒDEMA.

1. Passive in the aged.

SEROUS EFFUSION taking place into the connective tissue of the conjunctiva is by no means an uncommon occurrence among old and anæmic people, suffering from a relaxed condition of the mucous membrane; it may be induced by an attack of simple conjunctivitis or some such cause. The effusion generally comes on suddenly, and the œdema may be so great that the conjunctiva bulges forwards over the cornea, having much the appearance of a yellowish, jelly-like mass; there is no purulent discharge from the eye. There is little or no pain in the eye, and although it often happens that the patient is much alarmed as to his condition, we may quiet his fears by assuring him that, beyond the slight amount of stiffness caused by the effusion, no ill effects are likely to follow.

No discharge, or ill effects.

2. From inflammation or dropsy.

Serous effusion may, however, occur quite independently of old age, from inflammation of the conjunctiva, or of the neighbouring structures, or from remote causes—as, for instance, disease of the heart or kidneys. Excluding these cases, simple serous effusion is a matter of little or no consequence: it generally appears suddenly, and slight pressure over the lids by means of a compress and bandage causes it to disappear after a few hours. Should the œdema

Apply pressure.

Puncture.

be very considerable, we may puncture the jelly-like mass with a needle, and allow the serum to escape, subsequently applying a pad and bandage over the eye.

EFFUSION OF BLOOD. From blow or straining.

Effusion of Blood may take place into the connective tissue of the conjunctiva, either as the result of a blow or from violent straining—as, for instance, in whooping-cough. It occurs likewise from fracture of the bones of the orbit, and in fact from any cause by which the bloodvessels of the part are ruptured. The effused blood is at first of a deep red colour, usually disposed in blotches of greater or less extent beneath the conjunctiva, often encircling the cornea; as it becomes absorbed, various hues of discoloration are produced. It occasionally happens that the mucous membrane is slightly raised from its normal position by a clot of blood of this kind: under any circumstances, it presents a very unsightly appearance, and we are generally applied to for the relief of the disfigurement, rather than of the pain or inconvenience which it causes.

Disfiguring.

Soon absorbed.

Blood effused in this situation is usually speedily absorbed, and the process may be generally hastened by applying a compress and bandage over the eye. Should the effusion depend on the straining efforts made by a person suffering from whooping-cough, it is not likely to become absorbed until the violence of the fits of coughing has lessened; we may, however, safely relieve the minds of friends from any anxiety they may feel as to the ultimate issue of the case.

TUMOURS OF THE CONJUNCTIVA.

ENTOZOA.

Entozoa occasionally grow in the connective tissue of the conjunctiva; Hydatid Cysts,* and Filaria,† have been met with in this situation.

POLYPI. Usually small.

A **Polypus** may spring from the mucous membrane of the conjunctiva, appearing generally as a small tumour, but occasionally increasing to the size of a hazel-nut. These growths are usually pedunculated, and of a light pinkish colour, soft, and in fact presenting precisely the same appearances as similar formations in the nostrils or other parts of the body, with which also they are identical in structure. Polypi in this situation cause the patient no pain or inconvenience, unless they attain a considerable bulk. They may be removed with a pair of scissors, being snipped off together with a fold of the conjunctiva from which they grow.

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* "Ophthalmic Medicine and Surgery:" W. Jones, p. 685 3rd edit.

† "Annales d'Oculistique," t. xv. p. 133.

Easily removed.

Fatty Tumours

Fatty Tumours of small size sometimes spring from the connective tissue of the orbital conjunctiva. These tumours have a yellow, unctuous appearance, and seldom cause any pain or inconvenience to the patient except from their size and unsightly appearance. There is no difficulty in removing them: the tumour must be seized with a pair of forceps, and cut away with a fold of the conjunctiva from which it springs. The eye should subsequently be kept closed with a pad and bandage, till the wound in the conjunctiva has healed.

must be removed.

Warts.

Warts of the Conjunctiva are occasionally met with. They usually grow from the surface of the mucous membrane, near the margin of the cornea, and are of a greyish colour. Their surface is smooth, and a few fine hairs may usually be seen growing from them.

To be removed.

These small tumours should be removed, and a portion of the conjunctiva from which they grow should be included in the incision, otherwise they are almost sure to return.

Cysts.

Cysts of the Conjunctiva are rarely met with; they are seldom larger than a pea, and their semi-transparent appearance, particularly when examined by oblique light, at once indicates their nature. These cysts have been known to contain hydatids.

Should be removed.

A cyst growing in this situation should be completely removed, together with a fold of the conjunctiva from which it grows.

Epithelioma.

Epithelioma of the conjunctiva rarely commences on the mucous membrane of the globe of the eye, but has in many instances been known to spring from the connective tissue of the palpebral conjunctiva. I have already described the leading symptoms of this form of disease when discussing the affections of the eyelids, and it will therefore be unnecessary for me to enter further on the subject at present.

Cancer.

Cancer.—Medullary and melanotic growths occasionally spring from the conjunctiva. Several cases of the kind are recorded by M. Wecker.*

DISEASES OF THE CARUNCLE.

DISEASES OF THE CARUNCLE.—The caruncula lachrymalis is a small, reddish, conical body, situated at the inner canthus of the eye. It is composed of a mass of Meibomian glands, and is covered by a continuation of the conjunctiva. A few fine hairs grow from its surface.

Hypertrophy.

The caruncle participates in all the affections to which the conjunctiva is subject, and in some few cases it becomes chronically enlarged, looking like a small mass of florid granulations springing from the inner angle of the eye. Under these circumstances it may extend itself behind the upper and lower lids, and if touched is apt to bleed.

Apply tinct. opii, or cup. sulph.

Tincture of opium applied to the enlarged gland every day, by means of a camel's-hair pencil, usually effects a cure in such cases; or it may be necessary to smear it with sulphate of copper. It is not advisable if it can be avoided to excise the superfluous growth, because, should the caruncle subsequently become atrophied, the lachrymal puncta are displaced inwards, and troublesome epiphora, with its consequences, occurs.

Must not be excised.

A polypus springing from the caruncle should be snipped off with a pair of scissors, and the surface from which it grew touched with caustic; a little bleeding is apt to occur after this operation, but a sponge pressed firmly over the corner of the eye for a few minutes will stop the hæmorrhage.

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* "Maladies des Yeux," tom. i. p. 199. See also a case in "Handy-Book of Ophthalmic Surgery," by J. Z. Laurence and R. C. Moon, p. 60.

CHAPTER VIII.

DISEASES OF THE CORNEA.

General pathology—Vascular opacity—Keratitis—Keratitis punctata—Acute suppurative keratitis—Subacute — Ulceration — Hernia — Staphyloma — Fistula—Opacities—Conical cornea—Spherical, pellucid protrusion of cornea—Injuries of the cornea—Abrasions — Contusions — Penetrating wounds — Foreign bodies—Arcus senilis—Tumours.

GENERAL PATHOLOGY.

BEFORE commencing the consideration of the various diseases of the cornea, it will be well to take a general view of the pathological changes to which it is liable.

The cornea we know to be a non-vascular structure; and formerly, when hyperæmia was regarded as the first and most essential step in inflammation, it was difficult to see how the cornea could be the seat of it. But now that we have learned to look rather to the elements of a tissue as the point of departure for inflammatory changes, and to regard vascularity and hyperæmia, however important, as accessory phenomena, the cornea becomes one of the most appropriate tissues for the study and illustration of the modern doctrines of cellular pathology.

Nature of inflammatory changes.

Inflammatory changes, then, begin in the cornea, as in other parts, with a rapid multiplication of the cellular elements of the tissue, and the migration of leucocytes from the neighbouring vessels. In slighter cases this process may be superficial, and limited to the epithelial layers; but in severer ones the corpuscles of the proper corneal tissue, beneath the anterior elastic lamina, take part in the proliferation. This multiplication of cellular elements, either in the epi-

Causes of opacity.

thelial or deeper layers, or both together with corresponding changes in the intercellular material, are the principal causes of the opacity which marks the early stages of what we must still call inflammation of the cornea. This opacity may amount either to a superficial haziness from a ground-glass surface, or it may be of a deeper interstitial kind. The new, dense, opaque formations of "pannus" or vascular opacity of the cornea, are referrible to the development from cellular elements of a kind of connective tissue.

Formation of vessels,

In all cases the formation of vessels is secondary, and takes place chiefly by extension from the vascular textures around. It has been traced to the transformation of fusiform cells near the margin of the cornea, and their coalescence with similar structures in the conjunctiva.

and pus.

Lastly, the formation of pus, as in suppuration elsewhere, is due to a rapid production of cells of a lower grade, and the degeneration and deliquescence of the intercellular substance, together with the appearance of numerous leucocytes from the surrounding blood-vessels; these cellular elements may escape from the surface, as in ulceration, or be confined between the corneal lamellæ, and constitute an abscess.

VASCULAR OPACITY OF CORNEA.

Pannus, or Vascular Opacity of the Cornea.—Although pannus may be the result of keratitis, the distinction between these two affections of the cornea is obvious enough, for in pannus the cornea is usually uniformly opaque, as though covered with an adventitious coating, and the vessels branching over it are large, tortuous, and distinct from one another, the sclerotic and conjunctiva being only slightly congested. In keratitis, on the other hand, the opacity of the cornea is partial and of a ground-glass appearance, obviously from changes in the corneal tissue itself; the cornea is surrounded, to a greater or less extent, by a zone of very minute vessels, which advance only a slight distance from its margin towards the centre. The sclerotic zone of vessels is also well marked in the active stage of the disease, and the conjunctiva is more or less congested.

Contrasted with keratitis.

Sometimes follows it.

In some few cases of keratitis, large tortuous vessels extend themselves over the cornea, but in these instances the invasion is generally rapid, by vessels extending from the conjunctiva; the patient complains of considerable pain in the eye, and ciliary neurosis, and the cornea is uniformly hazy. As the disease becomes chronic, the pain subsides, and the congestion of the sclerotic and conjunctiva disappears, but the cornea remains opaque and vascular—in fact, pannus may then be said to exist.

May arise from ulceration;

Ulceration of the cornea may give rise to pannus; in almost all instances of healing ulcers, a vascular band can be traced from one or more points of the circumference of the cornea, extending towards the ulcer; and if the parts remain in a state of chronic irritation for some time, the vascularity of the cornea may continue, especially if that portion of it formerly occupied by the ulcer remains uneven, and therefore a source of irritation.

more often from granular lids.

But inflammation and ulceration of the corneal tissue are by no means the most frequent causes of pannus; vascular opacity of the cornea more often arises from the effects of chronic granular conjunctivitis, the palpebral surface of the conjunctiva having been rendered uneven from the cicatricial tissue which has formed, and being a source of constant irritation as it traverses the cornea in the movements of the parts. Under these circumstances, the superficial layers of the cornea often become opaque, and large tortuous vessels gradually extend themselves over its surface. The thickness of this vascular layer will of course vary in different cases; in some instances it is so dense that even the outline of the cornea cannot be distinguished from the sclerotic, while in others, the iris and pupil may be dimly visible through the semi-opaque and vascular cornea.

Density of vascular layer.

Other causes.

Pannus sometimes occurs as a sequence of suppurative or diphtheritic conjunctivitis, depending, as in the last case, on the destructive changes which have taken place in the palpebral conjunctiva. The same result may follow the prolonged action of any other mechanical irritant—as, for example, inverted eyelashes, whether arising from trichiasis or entropium.

Treatment.

The Treatment of vascular opacity of the cornea will naturally depend very much upon the cause of the disease; for instance, if arising from trichiasis, or entropium, the inverted cilia or margin of the lids must be either removed, or restored to their normal position, before we can hope to overcome the disease;

Remove the cause.

and if we can only succeed in getting rid of the source of irritation, we shall have every reason to expect that the state of the cornea will rapidly improve of itself.

If lids contracted,

In many instances of pannus, consequent on granular or diphtheritic conjunctivitis, the contraction of the cicatricial tissue following these affections of the eye shortens the lids from side to side, so that they press unduly and irregularly against the eyeball; this, together with the roughness of their surfaces, makes them act somewhat like a rasp against the cornea during the movements of the eyelids. Under these circumstances we must endeavour, in the first place, to correct this shortening of the eyelids, and for this purpose it will be necessary to divide the external commissure as described at p. 108. By this proceeding we not only elongate the palpebral fissure, and directly relieve the pressure exerted by the contracted eyelid on the cornea, but having divided some of the fibres of the orbicularis muscle, we weaken its action, and this again tends to lessen the pressure of the lids on the eye. Provided we can, by this simple proceeding, sufficiently relieve the friction of the palpebral conjunctiva against the diseased cornea, the pannus will probably disappear to a very great extent without further treatment; this desirable result is, however, frequently materially hastened if tannin be dusted freely over the cornea every morning, until the opacity of the cornea diminishes, when the tannin may be used every three or four days.

elongate palpebral fissure.

Excite purulent inflammation.

Supposing, however, that no favourable results follow this treatment, or that the condition is due to some other cause than contraction of the eyelids, we may still hope to improve the state of the cornea, by inducing purulent inflammation in the diseased eye. The more vascular the cornea, the less danger is there of the suppurative inflammation being followed by ulceration.

Precaution as to health.

The state of the patient's general health should be attended to before submitting him to this plan of treatment, for if he happens to be in a weak condition, sloughing of the cornea is more apt to occur.

Inoculation.

There is seldom any difficulty in exciting purulent inflammation in the diseased eye; but in some few instances the conjunctiva has been so completely altered in character, after long-continued granular conjunctivitis, that I have been obliged to inoculate it with pus on several occasions before I could succeed in establishing purulent inflammation.

The pus employed for inoculation may be taken from the eye of another person, suffering from purulent conjunctivitis, or gonorrhœal matter may be used. It should be placed on the everted lower lid, and a few slight punctures in the conjunctiva be made with the point of the lancet, so as to insure the grafting of the matter. In the course of thirty-six hours the contagion begins to grow rapidly, causing first irritation and inflammation, followed by purulent discharge.

Let inflammation run its course.

So long as the cornea remains free from ulceration we may allow the inflammatory process to run its course, simply keeping the eye scrupulously clean. If ulceration of the cornea supervenes during the progress of the disease, we must resort to the use of the dilute caustic pencil, strictly following out the treatment recommended in cases of purulent conjunctivitis. It is interesting to watch the effects of the inflammatory process on old-standing vascular opacities of the cornea; they often improve remarkably as the suppurative action subsides, and ultimately the patient may regain some amount of vision.

Chlorine lotion.

After the inflammation has entirely passed away, chlorine water may with advantage be dropped into the eye three or four times a day: it appears to act as a mild stimulant, and is certainly a useful remedy in cases of this kind.

Hot compresses.

M. Wecker recommends the application for two hours, morning and evening, of hot compresses to an eye affected with pannus; the inflammatory action thus induced, being, in his opinion, usually sufficient to destroy the pannus. Doubtless we can better control the suppurative action when excited in this way, than if produced by purulent matter; but the latter is nevertheless the preferable plan to adopt when the patient is in tolerably good health, and the cornea is covered by a considerable number of vessels. Among weak and sickly people, and when the pannus is not particularly vascular, it may be advisable to employ the hot compresses, or to smear the conjunctiva over with a crystal of sulphate of copper every other day, in this way exciting a mild and manageable form of

Preferable to inoculation in ill-health.

Cup. sulph.

suppuration. Powdered sulphate of soda, sprinkled over the surface of the cornea every day, has not been followed by the improvement we were led to expect from its use, at least among the patients under my care; but, as I have before remarked, tannin used in this way has in my hands often proved of service.

Syndectomy.

Another plan recommended for the cure of vascular opacity of the cornea, is to excise a band of conjunctiva and subconjunctival tissue about the eighth of an inch broad, extending entirely round the circumference of the cornea, so as to cut off the communication between the vessels of the conjunctiva and those covering the cornea.* This treatment is not to be relied on alone; it is useful when combined with purulent inoculation, but will not suffice of itself to improve a case of pannus. Formerly, it was the practice, after incising the conjunctiva as above described, to smear the wound over with nitrate of silver, but this plan of treatment has not, as a general rule, been found successful, and its results are not to be compared to those obtained by purulent inoculation.†

An adjunct to inoculation.

Resumé of treatment.

To sum up then: as a general rule, among robust and healthy patients suffering from pannus, after every mechanical cause of irritation, such as contraction of the lids, trichiasis, or entropium, has been removed, the diseased eye should be inoculated with purulent matter. In debilitated subjects, or when the pannus is not very vascular, instead of inoculation, hot compresses must be applied to the eyes for two hours, night and morning; or sulphate of copper may be smeared over the conjunctiva until suppurative inflammation has been excited. The disease may then be allowed to run its course, care being necessary, however, to prevent it advancing to such an extent as to endanger the vitality of the cornea.

KERATITIS. Pathology.

KERATITIS, DIFFUSE CORNEITIS, OR INFLAMMATION OF THE CORNEA, appears to arise, either from a primary perversion in the cellular elements of the tissue, or else from some defect in the supply of nutrient materials by the blood. However this may be, we find that in keratitis the transparent structure of the cornea is partially converted, by molecular and fatty degeneration of its elementary structures, into a semi-opaque material. The nature of these changes has already been referred to in the introductory remarks at the commencement of this chapter. As a general rule, keratitis affects both eyes, it may be at the same time, or consecutively.

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* *Ophthalmic Hospital Reports*, vol. iv. p. 23; Bader on Syndectomy.

† *Ophthalmic Hospital Reports*, vol. iv. p. 65: Case of Vascular Cornea and Granular Lids, by Mr. G. Lawson. One eye treated by inoculation, and the other by peritomy.

Opacity, mostly partial.

Symptoms.—The characteristic features of the affection are briefly these: the cornea presents an opaque appearance, either throughout its whole extent, or in parts; the remainder being transparent. Under any circumstances, the disease is usually more advanced in one part of the cornea than another. It generally commences towards the circumference and spreads inwards, but as it advances, the part first attacked may become transparent, while the centre of the cornea grows hazy. The diseased portion of the cornea is not only opaque, but its surface is no longer smooth, it resembles in appearance a piece of ground glass. This uneven condition of the anterior layer of the cornea is best seen by the lateral method of illumination, and in fact, unless examined in this way, may be overlooked. The immediate effect of these structural changes is to render the patient more or less blind, by interfering with the transmission of light to the retina.

Ground-glass surface.

Sclerotic zone.

In the active stages of the disease, a part, if not the whole circumference of the cornea, is surrounded by a zone of injected subconjunctival vessels, similar to that seen in iritis. In addition to the "sclerotic zone," in very many cases of keratitis, numerous minute vessels appear in the cornea, forming a semicircle at the circumference of its upper or lower section, or it may be forming an entire circle round the cornea. The vessels run from the margin, for about the eighth of an inch inwards, towards the centre of the cornea. By the unaided eye, these small vessels cannot be distinguished from one another, and the part appears as if it had been stained with a narrow band of vermilion, or smeared with blood.* In some few cases, this plexus of vessels is prolonged further inwards towards the centre of the

Vessels extend into cornea.

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* "Diseases of the Eye," by Dixon, 3rd edition, p. 88.

cornea, in which case the patient usually complains much of intolerance of light and supra-orbital pain.

Vascularity varies with the type.

The amount of vascularity of the subconjunctival tissue and cornea, will vary with the intensity and progress of the keratitis. In subacute and chronic cases these symptoms may be wholly wanting; nevertheless the cornea presents the peculiar ground-glass appearance of keratitis; this condition of the parts is particularly noticeable in instances of inherited syphilitic keratitis. In the more acute cases the orbital conjunctiva is congested.

Dimness of vision.

The patient may complain of lachrymation, and some intolerance of light, but he is most solicitous about the haziness of vision, of which he becomes painfully conscious if the opacity extend to the centre of the cornea. It is surprising what a complete impediment to useful sight, even a slightly nebulous state of the cornea may prove, if situated directly in the axis of vision; and the alarm of the patient, so long as the dimness of vision continues, though groundless, is very natural.

Photophobia and pain rare.

Intolerance of light and lachrymation are not prominent features in keratitis, so long as the epithelial layer of the cornea is but slightly affected; if these cells become entirely destroyed, and the peripheral distribution of the nerves exposed, not only does the patient suffer from photophobia, but complains also of considerable pain in the eye, and ciliary neurosis. These, however, are exceptional cases: keratitis, as a general rule, is not characterized by pain or great intolerance of light, but chiefly by dimness of vision occasioned by the hazy state of the cornea

Prognosis.

The natural tendency of keratitis is to terminate in recovery, although the process is frequently a very tedious one, extending over a period of several months, the disorder often attacking first one eye and then the other before it finally subsides, and we should warn our patients of this before undertaking the charge of the case; nor can we overlook the fact that in neglected instances of keratitis the iris may become involved, and the danger be only discovered after the cornea has cleared. We may suspect danger of this description, or even the extension of the disease to the choroid, if during an attack of apparent keratitis the patient complains of much ciliary neuralgia, pain on pressure over the ciliary body, and photophobia. Our prognosis will of course be far from favourable under such circumstances; but unless in complicated cases, the greater number of instances of the form of keratitis we are now considering make good recoveries.

Causes.

The disease is met with among people of all ages and classes, but the majority of cases occur among young and sickly children: I shall subsequently refer more particularly to instances arising from inherited syphilis. Keratitis may, however, come on quite independently of any specific influences, and it is often difficult to assign any positive cause for its appearance; occasionally it is a consequence of irritation by a foreign body or wound of the cornea.

Treatment.

Treatment.—Bearing in mind the fact, that the tendency of keratitis is to get well of itself, we need not be over-anxious to effect a cure. This remark of course applies only to uncomplicated cases, if other structures besides the cornea are involved, the case must be treated upon principles discussed under the headings of iritis, irido-choroiditis, and so on.

Counter-irritation.

Counter-irritation in the form of an issue opened in the skin of the temple, or a succession of blisters established in this situation, are doubtless frequently most serviceable, and hasten the reparative process in keratitis. Indeed, I hardly know of any disease of the eye which appears to be so much benefited by counter-irritation, and it should almost invariably form a part of our treatment.

Atropine.

Rest.

It is a good plan to drop a weak solution of atropine into the affected eye, so as to keep the pupil dilated; by this means we diminish the secretion of aqueous, and preserve the iris at rest—both desirable objects in the treatment of these cases. If the eye is irritable I usually order my patients to keep it closed by means of a pad and bandage, applied over the eyelids, to be worn during the day, but discontinued at night. No further local treatment is necessary.

Improve the general health.

The patient's general health must be carefully attended to; tonics, a generous dietary, fresh air, exercise, and often stimulants are demanded; leeches and antiphlogistics I simply mention, in order that I may condemn their use in cases of keratitis.

In instances arising from the presence of a foreign

Remove irritation. body in the eye, the offending substance should of course be removed. If, after an injury, there should be much irritation and pain in the eye, cold compresses may be kept constantly applied, and opium is often serviceable in allaying irritation.

SYPHILITIC KERATITIS. SYPHILITIC KERATITIS, NON-VASCULAR DIFFUSE CORNEITIS.—I have still to make a few remarks upon a special variety of the disease, described as inherited syphilitic keratitis. We are indebted to Mr. Hutchinson for the thorough investigation of this and some other forms of syphilitic affection of the eye. From a large collection of clinical material he has been enabled to show, that the majority of the cases, formerly described as "strumous" and "interstitial" corneitis, are of syphilitic origin.* The following case affords a good illustration of the origin and progress of this affection:—

Case. Jogender Nath Dey, aged sixteen, was brought to the Ophthalmic Hospital by his father, on the 2nd of September, suffering from syphilitic keratitis. The man informed me he had had five children, and that seventeen years ago, after the birth of his eldest son, he contracted syphilis. There seemed no reason to doubt that he then had chancre, which was followed by enlargement of the glands of the groins, and secondary symptoms. Jogender was born a year afterwards, and inherited the disease from which his father was suffering. I had an opportunity of examining his elder brother; he was perfectly free from any trace of the syphilitic taint; but my patient, who is the second son, and his two younger brothers, bore evidence of the existence of the disease in the state of their incisor teeth.

Primary syphilis of parent.

Keratitis in child. Jogender was a well-grown and remarkably intelligent lad; he stated that, as far as he could remember, he had enjoyed uninterrupted good health up to the present time, and that the affection of the eye from which he was suffering commenced about six weeks prior to his coming to the hospital. In the first instance, he noticed that objects held before his left eye presented a hazy appearance; ultimately, the sight of the right eye grew dim also, so that he is now nearly blind. During this time he suffered no pain or inconvenience beyond the gradual loss of vision.

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* *Ophthalmic Hospital Reports*, vol. i. pp. 191 and 226; and vol. ii. pp. 54 and 258.

Ground-glass cornea.

I found both eyes in much the same condition, the sclerotic and conjunctiva being perfectly normal, but the cornea presenting the ground-glass appearance of keratitis, with the characteristic zone of vessels round its margin: and, in addition to this, flocculent-looking spots, of a whiter hue than the rest of the hazy cornea, were scattered throughout its substance.

Characteristic teeth.

On examining this boy's teeth, the superior incisors were found to be widely separated from each other and club-shaped, their thin cutting edges being notched in the manner described by Mr. Hutchinson as pathognomonic of inherited syphilis, and plainly indicating the primary cause of the disease from which he was suffering. The following mixture was prescribed :—

Treatment.

Hydrarg. bichlor.	gr.j.
Potas. iodid.	ʒj.
Aquæ	℥viij.

Half an ounce to be taken twice a day after meals. He was also ordered to rub a drachm of mercurial and belladonna ointment over the forehead and eyebrows for twenty minutes every night; blisters were applied to the temples; and lastly, I directed him to take regular exercise, and a full and varied diet.

The medicines were used perseveringly; and on the 20th September, the report states that the left cornea was decidedly less opaque than at the commencement of the month. The mercurial ointment was now discontinued, but the mixture was repeated. On the 15th of October his eyes were very much better, and the iodide of iron was substituted for the bichloride of mercury. A month later both cornea were perfectly transparent, no vestige of the keratitis remaining.

Recovery perfect.

It is hardly necessary for me to mention, that when either parent has been affected with primary or secondary syphilis, their offspring are very likely to inherit the disease. The family history, the health both of parents and offspring, the particulars of previous illnesses, as well as the general appearance and physiognomy of the patient, will furnish materials on which to ground our diagnosis in suspected cases.

Diagnosis by history.

In a series of instances of keratitis and iritis occurring under these circumstances, Mr. Hutchinson noticed a peculiar formation of the incisor teeth, which ultimately led him to the conclusion, that their condition might be relied upon as an important test of the existence of inherited syphilis. A few delicate prominences are noticed on the edges of the central incisors: these gradually wear away after the child has used them for a time, and the free border of the tooth then becomes curved. A very common appearance of the syphilitic incisors is where some are notched and others conical or peggy. These are the permanent teeth; in the case of the temporary set, although often misshapen, irregular, and decaying, these characteristic forms are not apparent.

By syphilitic teeth.

Notched and peggy incisors.

Jogender Nath Dey's teeth were notched and irregular, and so were his younger brothers'; but it was rather the condition of my patient's eyes which led me at once to suspect that the keratitis from which he was suffering was syphilitic. In non-specific inflammation of the cornea, it is by no means an uncommon thing to see a portion of its laminated structure remaining transparent, while other parts present a ground-glass appearance. This is also the case in syphilitic keratitis; but in this form of disease the hazy cornea is always dotted over with patches of a denser opacity than that of the rest of the inflamed tissue, unless the case be near recovery, when the white spots gradually disappear, and the cornea ultimately resumes its usual transparency.*

Characteristic patchy opacity.

The average duration of syphilitic keratitis, if brought early under treatment, does not exceed three or four months, and sometimes it may disappear in even a shorter period. Unless in neglected cases, among poor and ill-fed people, ulceration of the cornea is by no means a common sequence of keratitis. The majority of cases certainly recover (unless complicated with iritis or irido-choroiditis), although if the process of cure be left entirely to Nature, it may take a very long time before the diseased action subsides; on the other hand, if assisted by appropriate treatment, a comparatively speedy recovery may be expected.

Ulceration rare.

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* *Ophthalmic Hospital Reports*, vol. i. p. 232: Mr. Hutchinson on Syphilitic Inflammation of Cornea.

It is rare to meet with an instance of inherited syphilitic keratitis occurring in a child under four years of age; opacities of the vitreous and lens from the same cause seldom make their appearance before the adult period of life. Inherited syphilitic iritis, on the other hand, generally commences when the infant is a few months old. **Age of patients.**

The Treatment of syphilitic keratitis should consist principally in attending to the patient's general health, and keeping his system in good working order, by simple, but at the same time, nourishing food, with plenty of fresh air and exercise. The affected eye should be kept at rest by a light pad of cotton wool and a bandage. ***Treatment.*** **Attend to general health.**

With regard to drugs, I believe that mercury may be judiciously used for the alleviation of this disease. The best mode of applying it in these cases is by inunction, the mercurial ointment being rubbed into the thighs and armpits twice a week for twenty minutes at a time. I never prescribe mercury internally for children, nor do I find it necessary to push the treatment so far as to affect the gums. In robust and healthy patients, therefore, suffering from syphilitic keratitis, begin at once with a course of mercury, and carry it on for four or five months, whether the disease of the eye be cured or not. Sickly children, however, cannot undergo this treatment, and cod-liver oil and iodide of iron, with occasional doses of hydrarg. c. creta, quinine, and soda, must be substituted for mercury. **Mercury with discretion.** **Cod-liver oil, &c.**

If there be no congestion of the vessels of the sclerotic or conjunctiva, a solution, consisting of two grains of iodide to an ounce of water, may with advantage be dropped into the eye twice a day. In almost all cases, an issue opened in the skin of the temple will prove serviceable. A bit of the integument being nipped up between the finger and thumb, a needle with a few threads of silk is passed through the fold; the thread is then tied in a knot, and left in this way for three weeks or a month. If the patient or friends object to an issue, we must apply a series of small blisters over the skin of the temples, but they are not so efficacious as the seton. **Iodine lotion.** **Issues very efficacious.** **Blisters.**

KERATITIS PUNCTATA, KERATITE PONCTUÉE, DOTTED KERATITIS, are terms employed by M. Wecker and **KERATITIS PUNCTATA.**

other writers to describe an affection in many respects analogous to "Aquo-capsulitis" of other authors. Dotted keratitis is by no means a common form of disease; it is characterized by the presence of a number of small white spots, scattered over the posterior elastic lamina of the cornea, consisting of patches of degenerated epithelium. This condition of the cells of the posterior elastic lamina is usually complicated with some amount of general haziness of the cornea, which, by interfering with the passage of light to the retina, renders the patient's sight very imperfect. The opaque epithelial cells are shed from time to time, and may sometimes be seen floating about in the aqueous, which becomes, in consequence, more or less turbid.

Degeneration of posterior epithelium.

Aqueous turbid,

Although the natural convexity of the cornea may be somewhat augmented, it does not appear that the aqueous is secreted in abnormal quantity, the altered curvature being due to structural impairment of the cornea; the tough posterior elastic lamina, and probably the laminated tissue, opposing less resistance to the distending force of the aqueous when affected with this form of disease. This view is further confirmed by the fact, that the tension of the eyeball is not increased in an uncomplicated instance of dotted keratitis, which would be the case if there were an excessive secretion of aqueous humour.

not in excess.

Cornea weakened, and yielding.

The symptoms to which keratitis punctata gives rise are seldom of an active kind—that is, the patient suffers from only slight pain in the affected eye, and dimness of vision caused by the opaque condition of the cornea.

No pain.

Dim vision.

On examining the eye, we notice, during the active stage of the disease, a zone of congested subconjunctival vessels surrounding the cornea, and usually there is a considerable amount of conjunctival congestion. There will generally be no difficulty in detecting the presence of the opaque patches of fatty epithelium on the posterior surface of the cornea; they are, however, best seen by means of transmitted light, and when the opacities are very faint, it may only be possible to make them apparent in this way. The aqueous will appear somewhat muddy, and flakes of degenerated epithelium are occasionally seen floating about in it; some of these may be deposited on the iris, giving it a speckled appearance.

Congestion.

Dotted opacity.

Muddy aqueous.

From the connexions of the posterior elastic lamina, it is evident that disease of this structure is likely to spread to the iris and ciliary body, and in practice we find that such is occasionally the case. Under these circumstances we have, superadded to the abnormal state of the cornea, symptoms indicative of disease of the deeper structures of the eye, such as increased tension of the globe, pain in the eye, and ciliary neurosis, intolerance of light, and inability on the part of the iris to respond to its natural stimulus, or to the action of mydriatics; but in uncomplicated cases of keratitis punctata, none of these symptoms are present.

Extension to iris.

Keratitis punctata is most frequently met with among children, particularly those suffering from a syphilitic or scrofulous diathesis.* It generally attacks both eyes, sometimes simultaneously, but more often consecutively.

Often syphilitic.

The ordinary course of this form of keratitis is towards recovery, unless complications arise as above indicated; the cure, however, is always a very prolonged one, and we should be careful not to give a favourable prognosis until we are quite sure that the deep structures of the eye are unaffected.

Prognosis good.

The Treatment of this form of disease resolves itself into the use of very much the same means as those recommended in cases of ordinary keratitis. It is generally advisable to have the affected eye closed with a pad and bandage, and atropine should be applied so as to keep the pupil dilated. In syphilitic cases, cod-liver oil, iodide of potassium, and mild mercurial preparations should be employed. In the majority of instances of non-specific origin, iron and quinine, and a tonic plan of treatment, will probably hasten the recovery; and in all instances of this disease counter-irritation is most valuable, in the form of either an issue or a series of blisters to the temple. Should complications arise, such as iritis or irido-choroiditis,

Treatment.

Rest.

Atropine.

Ol. mor.

Pot. iod.

Tonics.

Issues.

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* On Syphilitic Inflammation of the Eye, by J. Hutchinson, who has ably elucidated the syphilitic history of that form of the affection in which the iris participates, and which is more correctly designated as kerato-iritis: *Ophthalmic Hospital Reports*, vol. i. p. 192, and vol. ii. p. 278.

they must be managed according to the principles of treatment detailed under their respective headings.

Suppurative Keratitis. SUPPURATIVE KERATITIS, including abscess of the cornea, and onyx, may be conveniently described under two heads, the acute and the subacute.

1. Acute. 1. *Acute Suppurative Keratitis* is attended with considerable and often violent pain in the affected eye, extending to the eyebrow and temple. **Pain and photophobia.** The patient complains of intolerance of light and epiphora; the conjunctiva is usually much congested, and often considerable chemosis exists, concealing the injected zone of vessels which surrounds the circumference of the cornea. **Congestion.** The cornea itself is hazy, and as the disease advances suppuration takes place in its laminated structure. **Cornea suppurates.** The pus thus formed may escape externally, giving rise to an ulcer, or may burst into the aqueous chamber; or, lastly, it may gravitate downwards between the layers of the cornea to its inferior section, forming a yellow opaque patch, resembling in form and size the white mark seen at the root of the finger-nails, and hence the term onyx. **Onyx.** The superior border of this collection of matter is convex, and being situated between the layers of the cornea, it does not change its level as an hypopion does, when the patient bends his head over on one side. The collection of pus resulting from this form of keratitis seldom reaches as high as a line corresponding to the lower margin of the pupil.

Pus gravitates. The formation of pus occurs as frequently in the upper as in the lower section of the cornea; but in either case the result is the same. If it does not escape it descends to a lower level, either among the corneal fibres or between the laminated structure and posterior layer.

Prognosis good if pus escapes. The course which this disease pursues much depends on the situation of the abscess; if it be superficial, the pus makes an opening for itself externally, and comparatively little injury is done to the cornea; the pressure of the aqueous from behind not only tending to force the matter outwards, but also to keep the walls of the abscess in apposition when empty, so that the cavity occupied by the pus is thus effectually closed; and beyond a slight hazy appearance of the part, no vestiges of the disease may remain. Should it happen, however, that the haziness, though slight, is in the axis of sight, the patient will probably complain grievously of the impairment of vision which it produces.

Bad if retained.

Cornea destroyed.

Danger of spreading to iris.

Signs of iritis.

Suffering great.

If, on the other hand, the abscess is situated deeply in the laminated tissue of the cornea, the consequences may be most serious. The matter thus pent up is prone to spread among the corneal fibres, and inflict irreparable damage on its structure; or it may force its way between, and separate the posterior elastic lamina from its attachments. The chances of its finding a free vent into the aqueous chamber, through the posterior elastic lamina, are small, for an opening in the latter membrane is immediately closed by the outward pressure of the aqueous. Under these circumstances the diseased action will very probably spread to the iris and deeper structures of the eye. In cases of this kind, we can generally make out the condition of the parts by the lateral method of examination; the posterior layer of the cornea will be seen bulging backwards, and often touching the iris, and flakes of lymph and pus may usually be observed floating about in the muddy aqueous humour. The fibrous structure of the iris will be more or less hazy, and the pupil, in all probability, will refuse to dilate when atropine is applied to the eye; or if the iris does act, the pupil may assume all manner of shapes from the existence of anterior synechia. Under these circumstances, the pain in the eye and side of the head, from which the patient suffers, is often excruciating.

The eye may be lost.

The prognosis, then, in this second class of cases, is most unfavourable, for if the posterior elastic lamina be involved, general inflammation of the globe of the eye may at any time be excited. In other cases, the suppuration and destruction of the cornea continue until it can no longer resist the intra-ocular pressure, and the degenerated structure gives way, the contents of the eyeball escape, and the eye collapses; or if the rent in the cornea has not been very considerable, prolapse of the iris and a staphyloma may occur.

Treatment.

The Treatment of abscess of the cornea must be conducted upon the same principle as that of a similar collection of matter in any other part of the body. If the pain and ciliary neurosis are very great, as is usually the case, warm fomentations may be con-

Foment. Morphia.

stantly employed, and the subcutaneous injection of morphia beneath the skin of the temple must be resorted to. A solution of atropine should be applied to the eye every six hours.

Open abscess.

Whenever matter forms in the cornea, the sooner we make a depending opening into the part the better, so as to allow the pus to escape externally. In some instances the matter is thick and cheeselike, and will not readily flow through the incision in the cornea; if this is the case, a small scoop should be introduced into the abscess, and its contents evacuated. Our incision in the cornea should take an oblique direction, to avoid the risk of running the point of the instrument into the anterior chamber, which is very undesirable, because the presence of the aqueous is most serviceable in keeping up pressure from behind, and forcing the pus out through the external opening which we have made in the cornea.* There is generally little fear of this accident happening, for the posterior elastic lamina bulges backwards, leaving space between the middle and posterior layers of the cornea to allow of our being able to manipulate with freedom.

Avoid the anterior chamber.

Chloroform necessary.

I am in the habit of always administering chloroform in operations of this kind: it seems to me otherwise almost impossible to command the patient's eye, and open the abscess with due precision. The patient generally experiences great relief when the matter has been allowed to escape; subsequently hot poppy-head fomentations may be used three or four times a day, and in the intervals an ointment composed of morphia, belladonna, and Indian hemp should be smeared over the eyelids, and the eye kept closed with a light pad and bandage.

Sedatives and rest.

Should it appear that the iris has become involved, the treatment of the abscess in the cornea must still be conducted upon the principles above detailed; but we shall have to use frequent instillations of atropine, in order to dilate the pupil as speedily as possible. If the destruction of the cornea continues, and more particularly if the iris dilates irregularly under the influence of atropine, it may be necessary to perform iridectomy, and the sooner we resort to this operation,

Atropine in iritis.

Iridectomy.

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* "Traité des Maladies des Yeux," par A. P. Demours, t. i. p. 281.

under these circumstances, the better. I have but little faith in simply opening the anterior chamber and evacuating the aqueous fluid in cases of this kind.

Chlorine water.

Fomentations.

In some instances of suppurative keratitis, the tendency of the affection is to spread rapidly from the original seat of the disease, and yet the pain and irritation in the eye may have subsided. In this very dangerous class of cases, the chlorine water is a useful local application; it should be dropped into the eye three times a day, and a firm compress and bandage applied for four or five hours, but this must be discontinued, or the pressure lessened, if it increases the pain in the eye. Warm fomentations are very useful, unless there be considerable congestion and chemosis of the conjunctiva, in which case they are apt to augment the blood stasis, reducing still further the already defective supply of nutritive material to the cornea, and consequently hastening its destruction.

2. Subacute form.

2. *Subacute Suppurative Keratitis* differs from the acute form of the disease, in that there are no appearances of inflammatory action in the part, nor does the patient complain of pain or photophobia, except from complications hereafter described.

In debility

Yellow corneal patches.

Abscess.

It is most commonly met with among persons in a debilitated state of health; we see it for instance after cholera, starvation, or small-pox, especially among children, and it then pursues a very rapid course. The disease commences with the appearance of one or more yellow-looking patches of suppuration, situated in the laminated tissue of the cornea; these spots extend themselves rapidly, they coalesce; and in the course of a few days, or it may be hours, a considerable portion of the cornea is involved, and a collection of pus will have taken place in its lower part.

May burst externally.

The further course of the disease depends very much upon the extent and rapidity with which the degenerative changes progress, and also upon the position of the accumulated matter. If the pus has formed in the anterior layers of the cornea, the abscess may burst externally; but should it occupy the deeper layers, so as to involve the posterior elastic lamina, it is very probable that the diseased action will extend to the iris and deeper structures of the eye. The conjunctiva is then usually much congested, and the destruction of the cornea frequently progresses very rapidly.

Treatment. Support the strength.

The Treatment to be followed in these cases must be directed towards the restoration of the nutritive powers of our patients, so as, if possible, to stay the decay and death of the cornea. In all probability we shall have to resort to stimulants, a highly nutritious diet and tonics. Among the latter, the tincture of muriate of iron, given in twenty minim doses, with a grain of sulphate of quinine, every six hours, will sometimes be beneficial.

Open abscess. Atropine. Compress, and aq. chlor.

Should a collection of matter take place in the cornea, it must be evacuated as soon as possible, in the manner already described. Atropine must always be employed, particularly during the early stages of this disease. These cases beyond all others are influenced by a compress carefully applied over the eye, chlorine water being also employed. With regard to the compress, it is seldom likely to do good if it causes much pain in the eye, we must then slacken the bandage or leave it off for several hours during the day, and if there is not much conjunctival congestion, we may then employ the poppy-head fomentations. Unfortunately our best efforts are too often unavailing, the destructive changes in the cornea advancing so rapidly, that we have no time to improve our patient's health. The affection, moreover, having a constitutional basis, both eyes are often involved, so that the condition of the patient is indeed a most hopeless one.

Iridectomy, its great value.

Should other means fail, and the destruction of the cornea continue to advance, we are not only justified in performing iridectomy, but it is our bounden duty to do so at once, provided any portion of the cornea remain transparent. Under these circumstances it is advisable to remove about one-fourth of the iris from behind the transparent part of the cornea. Thus, supposing the lower half of the cornea has been destroyed, and its upper part is still transparent, we need not hesitate to make an opening into the anterior chamber through the superior part of the sclerotic, and remove at least a fourth of the iris. I do not attempt to explain the *modus operandi* of iridectomy under these circumstances, but I can assert most positively my conviction, that I have often seen a patient's sight saved by this proceeding, when no other prospect seemed to remain, but certain and incurable blindness; nor do I think it advisable to attempt to relieve symptoms of this kind by simply resorting to the operation of paracentesis of the cornea; valuable time may thus be thrown away and iridectomy perhaps delayed until it is too late to do any good.

Keratitis from nervous lesions.

Keratitis from Nervous Lesions.—In concluding this subject, I may briefly refer to a form of suppurative keratitis, which arises from defective innervation of the cornea, in consequence of which its nutrition is impaired, and degenerative changes, such as those above described, occur. The most common cause of this form of the disease, are wounds or injuries affecting the superficial branches of the fifth nerve. Thus we occasionally see rapid destruction of the cornea take place, apparently from the irritation caused by a foreign body lodged in the folds of the conjunctiva. Injuries affecting the origin or trunk of the nerve may induce a similar train of symptoms, which when once begun generally defy all our efforts to stop their progress.

Remove cause.

In cases arising from peripheral irritation of the nerve, we may, by the removal of the cause, put a stop to its injurious effects on the cornea. M. Snellen considers that in the analogous case of ulceration of the cornea, apparently arising from injury of the fifth pair, it is from the particles of dust and dirt which then find their way into the eye, that the destructive changes arise. He asserts that if, after injury of the nerve, the eyelids are kept perfectly closed, should ulceration occur at all, it is very partial in its effects.*

Protect the eye.

Sinitzin's experiments.

Dr. Sinitzin, on the other hand, considers that after injury to the fifth nerve, neuro-paralytic phenomena occur whether the eye is protected or not; he states that, having studied the effects of ablation of the superior cervical ganglion of the sympathetic nerve upon the eye in a large number of experiments, he has arrived at the following results:—1. Immediately after the ablation of this ganglion, increased vascular injection was constantly observable in the fundus of the eye of the same side. Ophthalmoscopic examination showed that the choroidal vessels had increased

Removal of cervical ganglion.

Hyperæmia of fundus.

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* *Annales d'Oculistique*, t. liii. p. 178; see also a case strongly confirming this view by Mr. Hulke, *Ophthalmic Hospital Reports*, vol. v. p. 177.

in size, that their anastomoses had become much more distinct, and that in general the fundus was of a much deeper red on the operated, than upon the sound side.

Increased heat.

2. The temperature of the eye of the operated side rose. In the sac of the conjunctiva and beneath the capsule of Tenon the difference in temperature amounted to as much as 0·9° to 2·4° Cent. 3. The cornea of the side operated upon possessed, when compared with the other, a much greater capability of resistance to the action of foreign and neutral substances. If, for instance, a fine spiculum of glass was inserted to an equal depth into each cornea, it always happened that, whilst on the sound side the spiculum excited more or less violent conjunctivitis, pannus, purulent infiltration of the cornea, with subsequent ulceration and ultimate disintegration of the adjoining tissue, or a more or less severe iritis and threatening of panophthalmitis—on the operated side either scarcely any reaction occurred, which was most commonly the case, or at most it was but slight.

Reaction on irritation lessened.

It was also observable that, as Claude Bernard has shown, the stronger the animal the greater the difference in the temperature, and the sooner after the operation the foreign body is inserted the greater is the resistance exhibited by the sound side.

Effects of section of 5th prevented.

4. The well-known neuro-paralytic phenomena consequent upon section of the fifth nerve in the skull, immediately in front of the Gasserian ganglion, do not occur if shortly before this operation, or immediately after it, the cervical ganglion is removed. 5. Even when some of these neuro-paralytic phenomena have made their appearance after section of the fifth, ablation of the ganglion will cause them to vanish in the course of a few (two to four) days. 6. Such disappearance is possible so long as the surface of the cornea remains moist and polished; if these conditions have supervened, separation of the epithelium, haziness of the cornea, as well as injection and swelling of the iris, they will no longer, disappear. 7. The complete atrophy or destruction of the eye consequent upon section of the fifth may still be staved off if the ganglion be removed during the progress of the changes, the conditions present either remaining *in statu quo* or undergoing more or less improvement. 8. The ulceration of the lips, especially of the lower one, following section of the fifth, as well as the ulceration of the eyelids, completely vanish after section of the

Protection of doubtful efficacy.

sympathetic. 9. For the improvement taking place under the four last heads it is not requisite for the animals to have any special protection from injury afforded. In Dr. Sinitzin's opinion, the neuro-paralytic phenomena after division of the fifth occur whether the eye of the side operated on is protected from irritation or not. 10. The diminution of temperature, observed by various experimenters on the same side ofter section of the fifth, never occurs when ablation of the sympathetic ganglion has been simultaneously performed. Dr. Sinitzin says that the changes in the circulation appear to be at the bottom of these effects. Ligature of the carotid, or irritation of the depressor nerve of the heart, neutralizes the inhibitory effects of the ablation of the sympathetic ganglion upon the neuro-paralytic phenomena consequent on section of the fifth.*

Iridectomy.

The treatment in these cases, when suppuration is established, is to be conducted upon precisely the same principles as in the case of abscess; it may be necessary to perform an iridectomy in order to save the transparent portion of the cornea.

ULCERATION AND ITS CONSEQUENCES.

ULCERS OF CORNEA.

General considerations

ULCERATION OF THE CORNEA may be conveniently considered for descriptive purposes under two heads, the acute and subacute, or sthenic and asthenic forms. We must bear in mind, however, that in practice we shall frequently meet with cases where it is difficult or impossible to say to which class they belong, the line of demarcation between acute and subacute ulceration being by no means a definite one; nor is the distinction of much importance in a practical point of view.

Cause loss of substance.

As a general rule, it may be affirmed, that ulceration of the cornea differs from ordinary keratitis in the loss of substance it occasions, and in the nature and result of the reparative process by which a cure is effected. Thus it frequently happens in the case of ulceration, that the cornea is permanently injured, and sometimes its transparency entirely destroyed, either by the formation of a dense cicatrix, or from perforation and staphyloma.

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* *Lancet*, 1871, p. 661, vol. i.

1. Acute or sthenic.

1. *Acute or Sthenic Ulceration of the Cornea* is always accompanied with great pain in the eye, and intolerance of light: these symptoms are often so severe, that it is almost impossible for the patient to open his eye, and the moment he does so, a gush of tears takes place, and the lids are involuntarily closed. The pain in these cases is often of an intermittent character, and usually increases towards bedtime, keeping the patient awake for hours together: it is by no means confined to the eye, but extends over the forehead and side of the head.

Pain severe.

Conjunctival and scleral congestion.

The palpebral and orbital portions of the conjunctiva are generally very much congested, and the sclerotic zone of vessels round the cornea is deeply injected. In very many instances the entire epithelial layer of the cornea is rough and hazy; but at one or more spots we shall notice that the cornea appears to have been eaten away or destroyed. The depth, extent, and situation of the ulcer will of course vary in almost every case.

Characters of ulcers.

The appearance also of the ulcer differs with the nature and stage of the disease; at first it looks like an opaque patch situated in the cornea, of a greyish colour; its surface is raised above the cornea, its edges shading off into the apparently healthy structure; but after a time the central portion of this spot degenerates and is thrown off, an excavation in the substance of the cornea becoming apparent. The base of the ulcer may be clear and transparent, especially if the disease has eaten down to the posterior elastic lamina, which has, apparently, considerable powers of resisting these destructive changes, and may remain perfectly clear, while the laminated tissue of the cornea above it has been entirely destroyed. The margins of these sthenic ulcers are generally well defined, but jagged and irregular, and of a greyish white colour.

Limited by elastic lamina.

Reparation of ulcer.

As the ulcer begins to heal, we may notice that it lessens in circumference, the reparation beginning at the edges and extending towards the centre. As this process goes on, blood-vessels will be seen coursing over the cornea and passing up to the edge of the ulcer; they gradually dwindle away as the ulcer heals. No sooner do the epithelial cells re-form, than the patient experiences the greatest relief from a cessation of the pain and photophobia from which he previously suffered.

It would be impossible to describe the various forms which ulcers of the cornea assume, but there are some varieties so frequently met with in practice that they require a word or two of special notice; among these the crescentic ulcer of the cornea is not only very dangerous, but most difficult to treat. These crescentic or encircling ulcers commence at the edge of the cornea, and look very much as if a bit of the cornea had been chipped out. The ulcer has not only a tendency to extend itself round the circumference of the cornea, but also to eat deeply into its substance. The supply of nutritive material is necessarily cut off from the central part of the cornea, and it may consequently slough. These cases of ulceration, though similar in their results to those occurring in purulent conjunctivitis, may arise quite independently of inflammation of the conjunctiva.

Encircling ulcer.

In other cases the ulcer assumes a funnel-shape, extending deeply into the cornea, and is very apt to perforate it in spite of our best efforts.

Perforating.

2. *Subacute or Asthenic Ulceration* of the cornea is not characterized by pain, photophobia, or any of the more urgent symptoms of irritation noticed in the acute form of the disease; there is seldom much congestion of the sclerotic or conjunctival vessels, and the ulceration is often a very tedious process, but, fortunately, has less tendency to involve the deeper layers of the cornea, and consequently to lead to a staphyloma, than the more acute forms of the disease.

2. Subacute ulcers.

These asthenic ulcers are generally superficial; their borders are well defined and sharp, as though a piece had been punched out of the cornea. Few if any vessels will be seen running up to them from the conjunctiva; in fact, there is evidence of want of action in the part, the ulcer neither spreading nor healing, except by very slow steps, or by fits and starts.

Superficial and sharp.

Inactive.

Prognosis.—This will depend more upon the depth and situation of the ulcer than upon its sthenic or asthenic character. Thus, even a subacute ulcer, from its long continuance, may involve the posterior elastic lamina, and ultimately set up lesions in the deeper structures of the eye; though such complications are doubtless more liable to occur in cases of sthenic ulceration, because the latter has a marked tendency

Prognosis, varies with depth and seat.

to spread, not only in circumference, but also to the deeper layers of the cornea.

Again, the course of sthenic ulcers being more rapid, when once they begin to heal, reparation goes on favourably, and the prognosis, so far as the ulcer is concerned, is favourable; but whenever there has been loss of substance in the cornea, whether by acute or subacute ulceration, more or less opacity of the part will remain, as a permanent mark of the original disease; and should this opacity happen to be situated in the axis of vision, the patient's sight must remain impaired. Much may perhaps be done by forming an artificial pupil, but still the injury inflicted by the ulcer is lasting.

Risk of cicatrices,

central opacity,

Unfortunately, this does not represent the whole risk of corneal ulceration: we have not only to fear the formation of a dense cicatricial tissue in deep ulcers of the cornea, but also that the attenuated cornea at the seat of ulceration may give way before the intra-ocular pressure, and that a staphyloma of the cornea and iris will occur.

and staphyloma.

The situation and depth, therefore, of the ulcer are always most important points to consider in forming a prognosis: superficial ulcers may heal, and the parts recover their normal transparency, but the effects of deep ulcers of the cornea are never overcome. Should the latter not extend to the centre of the cornea, they may still be comparatively harmless; but if, from thinning of the cornea, a staphyloma takes place, this, by involving the iris, as I shall subsequently explain, is apt to occasion the most serious mischief, if not absolutely to destroy the eye.

Effects of deep ulcers indelible.

Treatment.

Treatment.—It will be evident from what I have just said regarding the prognosis, that our main object in treatment must be to prevent, if possible, the ulcerative process from extending either in depth or area; for such extension must result in loss of transparency in the cornea.

Improve nutrition.

In most instances of ulceration (excepting traumatic cases, or those depending on conjunctivitis), the patient's general health will be found at fault;* in no affection of the eye is it more necessary to attack the disease by improving the assimilative and nutritive functions of the body, and as a general rule, a tonic and supporting plan of treatment is demanded. Iron and quinine, good food, cleanliness, and fresh air are the fundamental requisites for the cure of almost all instances of ulceration of the cornea, whether they be of the sthenic or asthenic type. One frequently sees cases of ulceration of the cornea which resist any kind of treatment, but which rapidly improve if the patient is sent to the sea-side, or still better, for a voyage to sea.

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* "Lectures on Diseases of the Eye," by J. Morgan, 2nd edition, p. 111.

Tonics, food, and air.

Opium is an invaluable remedy in cases accompanied with considerable pain and irritation of the eye—in fact, in what would usually be considered acute cases. For an adult, I generally prescribe about a grain of opium twice a day, sometimes in combination with soda and quinine. At the same time, a strong solution of atropine should be dropped into the eye three times a day; and the extract of belladonna having been smeared over the temple and eyebrow of the affected eye, the eyelids must be kept closed with a light pad and bandage.

Opium.

Atropine.

Pad and bandage,

The aim of all this is to insure the diseased cornea perfect rest; the opium allays the nervous and vascular irritation, and enables the patient to sleep; the atropine retracts the iris, thereby diminishing its secreting surface, and the quantity of aqueous which is formed, and this, by lessening the intra-ocular pressure, relieves the tension of the cornea. Lastly, the eyelids are kept closed, to exclude the stimulus of light, and prevent the lids rubbing against the ulcerated cornea.

to insure rest.

We must not forget that, in numerous instances, these means alone will not suffice to cure the ulcer, but that, as I before said, change of air and a tonic plan of treatment must also be resorted to.

In instances of sthenic ulceration it is not advisable to apply nitrate of silver to the ulcer; solid nitrate of silver should never be employed in these cases. The dilute caustic pencil, in experienced hands, may sometimes with advantage be lightly passed over the surface of rapidly-spreading ulcers of the cornea; in the majority of instances, however, more harm than good is done with nitrate of silver, and as a general rule I would not advise its employment in these cases. In

Caustic not to be used;

or other local remedies.

fact, all lotions or applications to the eye should be avoided in ulceration of the cornea, except the solution of atropine; this is the more necessary if we notice vessels passing from the circumference of the cornea to the border of the ulcer.

Iridectomy in rapid ulcers.

But it may be asked, Can nothing be done then to stop the progress and effects of a spreading ulcer, beyond keeping the parts at rest and the patient in good hygienic conditions? I believe there may. Bearing in mind what I have already stated regarding opacity of the cornea, following loss of substance, we may regard it as certain that that portion of the cornea which has been affected by such ulceration will become opaque, and consequently it matters little what becomes of the iris behind it. These considerations lead one to recommend, that in spreading ulcers of the cornea, if all other means fail, iridectomy should be performed, the iris being removed from behind the most transparent part of the cornea so that we shall subsequently have the advantage of an artificial pupil in this situation.

Advantages of.

I have no observations to make on iridectomy in these cases, beyond those I have already made in the case of suppurative keratitis, and which are equally applicable here. The proceeding is an extreme one, and should only be resorted to in cases which have resisted all other treatment, but this operation may then be had recourse to; if judiciously employed, it relieves the patient from pain, a rapidly-extending ulcer takes on a healthy action after the operation, and the results may be most satisfactory.

If less urgent draw off aqueous.

Supposing, however, that the ulcer is not advancing very rapidly, and the symptoms do not appear to be sufficiently urgent to demand so grave an operation as iridectomy, we may possibly avert the formation of a staphyloma, or perforation of the cornea, by opening the anterior chamber with a broad needle, and allowing the aqueous humour to escape. In this way we can relieve the tension of the cornea, and diminish the chances of the aqueous bursting through its attenuated structure at the point of ulceration.

Paracentesis of cornea.

In performing paracentesis of the cornea under these circumstances, the point of the needle should only just be allowed to pass through the floor of the ulcer into the anterior chamber, otherwise the iris, or even the lens, may be wounded. It is by no means necessary to wait until the deeper layers of the cornea are involved before performing paracentesis; on the other hand, there is much to be gained by resorting to this operation before the deep layers of the cornea are affected, for we thus limit the opening in the cornea to that of the size of the needle we introduce, in place of having a large rent through the bottom of the ulcer. The puncture should be made with a needle, so that the aqueous may escape slowly. Under these circumstances the iris gradually moves forward as the aqueous escapes, and comes to rest against the opening in the cornea, very likely adhering to it by neoplastic formations; but these give way as the cornea closes, the aqueous thrusting the iris and lens back into their normal position. If, after puncturing the ulcer we notice, in the course of a few days, that its base is again bulging forwards and likely to burst, we must again perform a paracentesis, and we may have to repeat the operation more than twice. After each occasion on which the cornea is opened, the eyelids and temples should be smeared over with the extract of belladonna, or the atropine ointment, and the eye kept carefully closed with a light compress and bandage.

Directions.

If the ulcerative process be asthenic, want of action characterizing the disease, and few if any vessels passing from the conjunctiva to the ulcer, we may stimulate the part by hot compresses applied over the lids, for an hour, once or twice a day; or calomel, dusted over the ulcer from time to time, will be useful.

Asthenic ulcers.

Hot compresses. Calomel.

In these chronic ulcers of the cornea, which are also apt to recur, it is advisable to employ a seton. A needle armed with stout silk or twine is passed through a fold of skin in the temporal region, so as to include about an inch of integument, the silk is then tied in a loop, and the wound dressed morning and evening; the seton may be kept open for a month or two.

Setons in chronic ulcers.

But if we notice that vascularization of the cornea has commenced, and is extending up to the border of the ulcer, we may safely discontinue all treatment, simply keeping the pupil dilated, and the eye closed with a compress and bandage. The process of cure will usually be greatly expedited by change of air, a

Hygienic measures.

well-regulated dietary, and other means tending to improve the patient's general health.

In cases of ulceration of the cornea complicated with perforation, I would refer the reader to the section on prolapse of the iris.

HERNIA OF CORNEA.

HERNIA OF THE CORNEA consists in a protrusion of the posterior elastic lamina through the outer layers of the cornea, which may have been destroyed by ulceration. This elastic lamina has considerable power in resisting destructive changes, and hence, after the laminated tissue of the cornea has been destroyed, it may remain unaffected, and being forced outwards by the pressure of the aqueous, form a little glassy-looking nodule, projecting from the corneal surface. The transparent appearance of the tumour, bulging through the jagged border of the ulcer, is sufficiently characteristic to enable us at once to recognise the nature of the disease.

Elastic lamina protrudes,

as a glassy nodule.

From the extreme thinness of the posterior elastic lamina, it necessarily follows that, when a hernia of this kind has occurred, the slightest force applied to the eye is likely to rupture it. Hence herniæ of the cornea are of short duration, and seldom come under observation, the posterior elastic lamina usually giving way before the distending force of the aqueous, and the corneal hernia being replaced by a prolapse of the iris. It occasionally happens, however, that the hernia remains for some weeks, and gradually becomes converted into cicatricial tissue.

Often bursts.

Treatment.

Treatment.—The patient having been placed under the influence of chloroform, and a stop speculum adjusted, a broad needle should be run through the cornea, and the instrument being tilted on its edge, the aqueous is allowed to escape slowly from the eye. The needle is then to be removed, and a solution of atropine dropped into the eye, a compress and bandage being firmly applied over the closed lids, and kept there for forty-eight hours. The eye may then be examined, but it will be better to re-apply the compress, and continue its use for some days.

Draw off aqueous.

Apply a compress and bandage.

The object of this treatment is to draw off the aqueous, and allow the hernia of the cornea,—that is, the posterior elastic lamina,—to resume its normal position, and then to keep it there, by means of the compress, till cicatricial tissue shall have formed over it. It is advisable before closing the eye, in cases where there is apparently defective action in the ulcer, to stimulate its edges by touching them with a dilute caustic pencil, and then to apply the compress and bandage over the lids.

Dilute caustic.

It may be, that on opening the lids at the expiration of forty-eight hours, we find the hernia of the cornea reproduced, in which case the paracentesis must be repeated, the compressing band and the caustic pencil being again applied. This treatment will soon excite sufficient inflammation in the part, to set up material changes in the ulcer, and although a cicatrix will remain as a permanent blemish, still, its formation will prevent a prolapse of the iris with its attendant evils.

Repeat if needful.

STAPHYLOMA OF THE CORNEA AND IRIS.—If the resisting power of the fibrous structure of the cornea has been destroyed, or considerably weakened by the ulcerative process, the remains of the laminated tissue, together with the posterior elastic lamina, are very likely to yield to the distending force of the aqueous; and bulging forwards, to a greater or less extent, they form what is called a staphyloma of the cornea.

STAPHYLOMA OF CORNEA.

Weakened cornea bulges.

From their relative positions, it follows, that when a partial protrusion of the cornea occurs, the iris is apt to be carried forward into the protrusion. Moreover, in the majority of these cases, a small opening occurs at the most prominent part of the staphyloma, through which the aqueous drains away; or the aqueous may percolate through the attenuated portion of the cornea; in either case, the anterior chamber being emptied, the vitreous forces the lens, and with it the iris, forwards against the cornea. The iris thus frequently becomes entangled, adherent, and ultimately firmly glued down to the inner surface of the protrusion (*vide* Fig. 23,) while its outer surface acquires a coating of fibrous (cicatricial) tissue, and thus the staphyloma ultimately assumes a dense opaque appearance, and is lined by a portion of the iris.*

The iris follows,

False coating formed.

Staphylomata of this kind vary much in size, sometimes being so large that they protrude between the eyelids, at other times they are no larger than a pin's head. The thickness of their walls is also subject to variation: in many instances the summit of the staphyloma is very thin, whereas in other cases it is comparatively thick, and may contain a considerable quantity of cholesterine imbedded in it.

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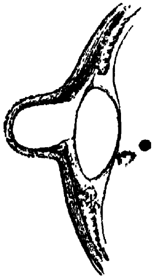
* "Augenheilkunde," Stellwag von Carion, p. 121.

FIG. 23.



Perforation or rupture.

The apex of the staphyloma, as I have before remarked, may ulcerate, and a fistula form, through which the aqueous drains away: or the staphyloma may burst open, and through the rent thus made, the lens, and, in fact, the contents of the globe, escape; the eyeball then shrinks up, and sinks into the orbital socket.

Composite forms.

It sometimes happens that more than one staphyloma exists in the same cornea. This condition arises from the previous formation of several ulcers in the cornea, which has accordingly yielded at more than one spot to the intra-ocular pressure, while the intermediate parts, retaining their fibrous structure, have effectually resisted the distending force, forming bands between which the several small staphylomata have occurred.

Effect on vision.

The symptoms to which a staphyloma of the cornea gives rise consist principally in various degrees of impairment of vision, and will depend very much upon its position and size. When endeavouring to estimate what may be the ultimate effect of a staphyloma on the patient's vision, the condition of the iris is one of the first points for consideration, in instances where a portion only of the cornea is involved. Should the iris have been drawn into the protrusion, it is very probable that the pupil may likewise be included in the staphyloma, and of course the patient will not be likely to see much with an eye so affected. In other cases a part of the pupil may remain free, and should there be any transparent cornea in front of it, the patient may still retain a fair amount of sight. Again, supposing the staphyloma leaves the centre of the cornea clear, it is far less likely to impair the sight than if situated in the axis of vision. It is by no means an uncommon circumstance, however, for glaucomatous

If pupil included, little sight will remain.

changes to occur in an eye in which a staphyloma has become developed; the degree of tension of the eyeball must therefore be carefully attended to in cases of this kind.

Treatment.

Treatment.—This will depend on the size of the staphyloma and the length of time it has existed.

1. If small let aqueous escape.

Apply compress and atropine,

1. If the protrusion be a small one, and of recent formation, the best thing we can do is to puncture the inferior part of the staphyloma with a broad needle, so as to allow the aqueous to escape, and then apply a firm compress and bandage over the eye; the instillation of atropine should also be employed. Our first object in this proceeding will be to empty the anterior chamber of aqueous, which is probably forcing the staphyloma outwards; the intra-ocular pressure being thus removed, the compress not only prevents a re-formation of the staphyloma, but also stimulates the part to increased action, hastening the formation of cicatricial tissue, which effectually retains the parts in their normal position. The atropine is employed with the view of retracting the iris, so as, if possible, to disengage it from the cornea.

or remove with scissors.

If the staphyloma does not yield to this treatment within a fortnight or three weeks, it will be well to put the patient under the influence of chloroform, and then snip off the protrusion with a pair of sharp scissors. A strong solution of atropine must subsequently be dropped into the eye, and a firm compress and bandage applied, and retained in its position till the wound in the cornea has healed.

2. If large, excise iris.

Aqueous lessened.

2. If the staphyloma is a large one—involving, say, a quarter or more of the cornea, we must resort to an iridectomy, as the surest means of treatment under these circumstances. If this be neglected, it is very probable that the iris and pupil will subsequently be drawn into and become attached to the cornea; we anticipate this evil, by excising at once a fourth of the iris from behind the clearest portion of the cornea, we release the iris from its attachment, and by diminishing its secreting surface lessen the quantity of aqueous formed, so that we may hope, by the careful application of a compress and bandage subsequently to the iridectomy, to reduce the dimensions of the staphyloma itself; and beyond this, prevent glaucomatous changes from taking place in the eye.

Besides the immediate advantages to be derived from this proceeding, we must bear in mind the fact, that if the iris becomes permanently involved in a staphyloma, it may give rise to sympathetic irritation in the other eye; this is therefore an additional reason for resorting to iridectomy in this class of cases as early as possible.

3. If old and large, apply atropine.

3. In instances of large and old staphylomata, in which a portion of the cornea remains transparent, a similar plan of treatment must be adopted. In the first place, it will be necessary to apply atropine to the eye, in order that we may discover the state of the pupil, whether it remains partially open, or has been entirely occluded and dragged into the staphyloma.

Iridesis, if pupil free.

In the former case, it will dilate under the influence of atropine, and, if practicable, we must form an artificial pupil.

On the other hand, supposing the pupil has been dragged into the staphyloma, it follows that the communication between the anterior and posterior chambers of the eye will have been closed; hence, fluid collecting in the latter will cause abnormal pressure upon the retina and deeper structures of the eye, which, unless relieved, will certainly terminate in total loss of vision.

Iridectomy, if pupil closed.

Under these circumstances we have before us a choice of two proceedings: either the formation of an artificial pupil, or else an iridectomy. I prefer the latter, because in many cases of the kind, the artificial pupil does not establish a sufficiently free communication between the chambers of the eye to prevent the occurrence of intra-ocular pressure; and secondly, because we often find, after making our artificial pupil, that we have to deal with an opaque lens behind the iris.

Advantages of iridectomy.

Now, by performing an iridectomy, we not only open a free communication between the chambers of the eye, but having excised the iris (the patient being under the influence of chloroform), we may, if the lens is opaque, proceed at once to remove it by means of the scoop operation.

I should weary the reader were I to attempt to describe the numerous operations proposed with the very simple object of removing a staphyloma of the cornea. All that is necessary, however, is to excise the protuberance, and allow the contents of the globe to escape, after which the eyeball will contract and form a good stump on which to rest an artificial eye. Among other proceedings for the removal of a staphyloma, the following may be mentioned :—

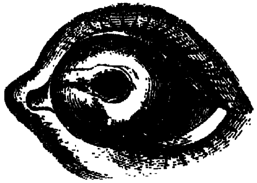
Removal by ligature.

If the staphyloma is extensive, but confined to one part of the cornea, we may destroy it in the following manner :—The base of the projection is to be transfixed by two needles at right angles to one another, and the staphyloma is then to be surrounded with a silk ligature, which is prevented from slipping up by means of the needles ; these should be cut off close to the points of puncture. A pad and bandage is subsequently applied, and in three or four days the staphyloma may be expected to fall off, leaving a good stump for an artificial eye.

4. Abscise a complete staphyloma.

4. In instances of staphylomata, involving the whole of the cornea, and being an inconvenience to the patient, not only on account of their unsightly appearance, but also by interfering with the action of the eyelids (Fig. 24), we may remove the protuberance in the following way :—

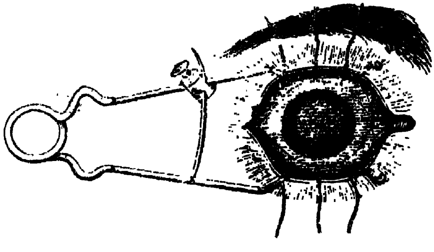
FIG. 24.



Operation of abscision.

The patient having been placed under the influence of chloroform, a stop speculum is adjusted, and the surgeon transfixes the globe of the eye, in a line corresponding to the ciliary processes, with a couple of needles, armed with a stout silk suture (Fig. 25). The staphyloma is then to be secured with a pair of toothed forceps, and that part of the globe of the eye anterior to the suture is to be removed with a knife or a pair of scissors. The ends of the suture are then to be tied, so as to bring the edges of the wound in the sclerotic together, the speculum removed, and water-dressing applied to the eye. In the course

FIG. 25.



of a few days, the suture may be taken away, and the edges of the wound in the sclerotic will have united.

Mr. Critchett's operation.

Mr. Critchett, who first introduced this operation, called Abscission of the eyeball, transfixes the globe, immediately behind the limits of the intended incision, with four or five delicate curved needles, armed with black silk, and he does not withdraw the needles until he has abscised as much of the eye as is necessary, the presence of the needles preventing the escape of the lens and vitreous. "In the large majority of cases," he observes, "union takes place by the first intention. I generally leave the sutures in for some weeks. Sometimes they come away spontaneously."* In my own practice I have entirely discontinued the use of sutures, but in cases of complete staphyloma I am in the habit of seizing the staphyloma with a pair of toothed forceps, and simply incising the anterior hemisphere of the eyeball, the contents of the globe are allowed to escape; and then, without attempting to close the wound in the sclerotic with sutures, apply cold water dressing for a few days, with a light compress over the closed eyelids. I find this proceeding causes less irritation, is less painful, and produces an equally good stump for an artificial eye as the above described proceeding of abscission. I have never seen hæmorrhage, which could not easily be controlled by pressure, follow an operation of this kind, and there is far less chance of suppuration of the globe of the eye than when sutures are passed through the sclerotic.

Abscission when preferable to excision.

With regard to the circumstances which render the operation of partial abscission preferable to total excision of the eyeball, in cases of complete staphyloma of the cornea, I cannot do better than quote from Mr. Lawson's work. He says, "My own feeling is, that to the wealthy, where personal appearance is a source of serious moment, the operation of abscission is most valuable, as the patient can keep a watch over the stump, and seek medical aid the moment any unpleasant symptoms arise; so that if at any time it should give trouble or become dangerous to the other eye, it can be immediately removed. To the poor, however, where safety stands so much before symmetry, and where neglect of early symptoms is the rule rather than the exception, it is better to remove the staphylomatous eye entirely, rather than to abscise the front of it."*

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* *Ophthalmic Hospital Reports*, vol. iv. p. 8.

Fistulæ of Cornea.

Fistula of the Cornea is an occasional sequence of ulceration, the opening through the cornea usually taking an oblique direction, and being prevented from healing by the constant drain of aqueous through it.

May cause capsular cataract,

No sooner does perforation of the cornea take place, than the iris and lens are thrust forward, and should the capsule come in contact with the internal opening in the cornea, it is likely to give rise to partial capsular cataract. But even more serious consequences may be expected to follow if the fistula remains open; for the constant dribbling away of the aqueous diminishes the intra-ocular pressure, and gives rise to anomalies in the circulation through the choroid and retina, terminating, probably, in extensive disease of the fundus of the eye. Anterior synechia, again, may form in instances of fistula, from the contact of the iris with the cornea; and when this has taken place, irritation of the iris is apt to be induced, and extending to the choroid may compromise the eye, and involve the sound one by sympathetic irritation.

and other intra-ocular changes

Causes.

A fistula of the cornea may arise from other causes than ulceration, as for instance a penetrating wound which has been prevented from entirely closing by the drain of aqueous through it. But from whatever cause produced, the fistula may at any time lead to complications such as those I have mentioned above.

Appearance.

We can seldom overlook the existence of a fistula of the cornea; its external orifice may generally be clearly seen, a minute drop of aqueous oozing through it, when gentle pressure is made on the globe of the eye. The depth of the anterior chamber is much diminished, and in many instances the iris is thrust forwards against the posterior surface of the cornea.†

Treatment.

Treatment.—These fistulous openings in the cornea are difficult to heal, on account of the drain of aqueous through them; the lens, moreover, being thrust against the internal orifice of the cornea, keeps up irritation in the part, tending yet further to interfere with the healing of the fistula.

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* "Injuries of the Eye, Orbit, and Eyelids," by G. Lawson, p. 98.

† "Traité des Maladies des Yeux," par A. P. Demours, tome i. p. 308.

Crucial incision in cornea,

In cases of this kind, the best plan of treatment is to administer chloroform, and having separated the lids with a spring speculum, to pass a blunt-pointed needle, with a cutting edge, through the fistula, and incise the whole thickness of the cornea from above downwards, and from side to side. The edges of a crucial incision of this kind will fall into accurate apposition; and if a compress and bandage be carefully applied, it is more than probable they will heal in the course of forty-eight hours, and the fistula be cured.

and compress.

Avoid lens and iris.

I need hardly remark that too great care cannot be taken to avoid wounding the lens or iris with the point of the needle. This may generally be managed on account of the oblique direction of the fistula; moreover, with the patient well under the influence of chloroform, and laid on his back, the lens falls away from the cornea, and thus materially lessens the difficulty.

Another operation.

M. Wecker considers that in these cases of fistula the edges of the inner orifice, formed by the posterior elastic lamina and its epithelium, are often everted, and lining the passage, prevent union; and he therefore recommends the introduction through the fistula of a pair of very fine forceps with smooth points, by which the walls of the fistulous track are to be seized, the lining of it bruised, and the proper corneal tissue denuded. Atropine is then to be applied, and a compress and bandage worn.* In this proceeding care must be taken not to injure the capsule of the lens.

Compress and bandages. Atropine.

Before resorting to this treatment, we may be inclined to try what a simple compress and bandage, applied over the eye, will do, a solution of atropine at the same time being dropped into it twice a day, in order, if possible, to dilate the pupil. In addition to this somewhat expectant plan of treatment, the external orifice of the fistula may be touched with a finely-pointed pencil of dilute caustic every two or three days; but I would not advise much time to be expended on this kind of treatment; it seldom succeeds, and it is probably better, in most instances, to divide the fistula as soon as possible by a crucial incision, such as I have above described.

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* *Ophthalmic Hospital Reports*, vol. v. p. 395.

Dilute caustic pencil.

Iridectomy has been recommended in these cases, but I can hardly think it necessary, unless the fistula be complicated with traumatic cataract, in which case the principles of treatment will be discussed under the head of injuries of the lens.

Opacities of Cornea.

OPACITIES OF THE CORNEA.—Opacities of the cornea vary greatly in extent and density, as well as in their permanency, according to the circumstances which have given rise to them. The opaque condition may amount only to a milky cloudiness, extending over the whole cornea, or confined to certain portions of it; and which again may be limited to the superficial layers, or occupy the substance of the proper corneal tissue. In other cases, as where it has resulted from the process of repair, following considerable loss of substance in the cornea, the opacity is much denser, and has more or less the character of an adventitious formation or cicatrix. The denser varieties of opacity are usually described as *leucoma*; hazy, semi-opaque forms are called *nebulæ*.

Varieties.

Leucoma and nebulæ.

The more superficial opacities are due to a fatty, molecular cloudiness of the epithelial cells, and generally arise from superficial keratitis, ulceration, or mechanical irritation of the cornea. The deeper varieties, which occupy the substance of the proper corneal tissue, result from the proliferation of the corneal cells, occurring in the progress of keratitis which has not been confined to the epithelial layers. The loss of transparency which remains, when all active disorder has ceased, appears to be due, partly to the presence of groups of shrunken nuclei, partly to a molecular fatty degeneration of the intercellular material: such are the flaky opacities of interstitial or syphilitic keratitis. Lastly, where there has been considerable destruction of corneal tissue from ulceration or other injury, and the gap has been filled by new formation, although transparent corneal fibres are reproduced under favourable circumstances, yet

Kinds and degrees of structural change.

the process is incomplete and confined to the deeper parts, while those towards the surface acquire more or less the character of an opaque fibrous or cicatricial tissue.

Limits of restoration.

Cicatrices never transparent.

In the epithelial and interstitial opacities, which depend on the presence of degenerate cellular and intercellular products, these may in time be cast off or absorbed, and their place supplied by a higher formation: hence these opacities often clear away more or less completely, and we shall have the better reason to expect such a result the more recent the affection, and the younger and more vigorous the patient. On the other hand, whenever there has been considerable loss of corneal substance, which has been replaced by cicatricial tissue, restoration of transparency is impossible. Such new formations, however, are often surrounded by a margin of cloudy opacity, which may clear away spontaneously.

Prognosis.

Artificial pupil the only remedy in leucoma.

Prognosis.—The chief points for consideration, in forming a prognosis in instances of opacity of the cornea, are the situation and extent of the structural changes that have taken place. For the reasons already stated, a dense leucoma can never be removed, and if it be situated in the axis of vision, our main hope will rest in forming an artificial pupil should any part of the cornea remain transparent. If the leucoma on the other hand is eccentric, and the pupil is in its normal position, the opacity will be of comparatively little consequence. It generally happens, however, that the border of a leucoma shades off into a nebulous area, and if this extends in front of the pupil, it may be almost as detrimental to the perfection of vision while it lasts, as a more dense opacity would be.

Nebulæ may clear off or shift.

In the case of nebulæ, where the cause which gave rise to them is no longer in operation, nutrition vigorous, and the patient young, we may confidently look for a spontaneous disappearance or great diminution in the opacity; but this must always be a work of time. Some varieties of nebulæ, more especially those which are the result of syphilitic keratitis, are apt to shift from one part of the cornea to another, and a change of position, with regard to the axis of vision, may greatly modify their effect on the sight. If situ-

Nebulæ easily overlooked.

Yet greatly hinder vision.

ated in the deeper layers of the laminated tissue, or in the posterior layer of the cornea, nebulæ may be easily overlooked, unless the part is carefully examined by the lateral method of illumination. We cannot, therefore, be too careful in exploring these parts, when dimness of vision is complained of; for opacities, though so faint that they are with difficulty detected, may be enough to scatter the transmitted light, and so offer very serious embarrassment to distinct vision, and be a constant source of annoyance to the patient.

May cause myopia.

Slight opacities of the cornea, if of long duration, may induce myopia. The haziness of the transparent media, by diminishing the clearness of the visual image, causes the patient constantly to exert his accommodative power in vain efforts to attain distinct vision, and this ultimately leads to hypertrophy of the contractile tissue which determines the curvature of the lens; its anterior surface thus remains abnormally convex, and the result is a permanent myopia, although the opacity of the cornea may subsequently clear away.

or strabismus.

Strabismus, again, is occasionally a result of central opacities of the cornea, the strain of accommodation, and associated increased action of the internal rectus muscle, inducing strabismus of the weaker eye. This tendency is augmented by the necessity that exists of excluding from binocular vision the eye which is clouded, in order to maintain the most distinct impressions when fixing an object. Should the opacity continue for any length of time, the sensibility of the retina may be destroyed, and the eye rendered useless for optical purposes. But myopia and strabismus are rare complications of corneal opacity; the patient usually complains simply of dimness or loss of vision, depending on, and proportional to, the position and density of the opacity of the cornea.

Causes.

Glaucoma.

Iriti

Keratitis.

The Causes which give rise to opacities of the cornea are numerous. Glaucoma, for instance, may render it hazy, the changes which occur in the choroid affecting the long ciliary nerves, and hence impairing the innervation and nutrition of the cornea. In certain forms of iritis, the posterior layers of the cornea are often involved, and this may give rise to opacities in that situation. Keratitis punctata, and the various forms of inflammation and ulceration of the cornea, are frequent causes of leucoma or nebulæ.

Chemical agents.

Chemical agents again, by destroying the vitality of the tissue, may induce opacity of the cornea. Acetate of lead, applied as a lotion to the eyes, by chemical decomposition with the lachrymal secretion, may be converted into carbonate and become deposited on the cornea in the form of a permanent opacity, especially if its surface happens to be ulcerated or uneven at the time the lotion is used. In like manner, nitrate of silver may, in the course of time, stain it almost perfectly black. I have at present an old lady under treatment who was ordered, many years ago, nitrate of silver drops for her left eye; she went on using the lotion for a long time, until, in fact, she had stained the cornea and conjunctiva of so dense a black, as entirely to conceal the iris and pupil. The eye has been in this state for twenty years, without the slightest sign of improvement—a tolerably good proof that the laminated tissue of the cornea does not undergo disintegration and removal so rapidly as some persons have supposed. Opacities of the cornea, again, may be induced by the deposit of calcareous matter on its surface.

Illustration.

Wounds and injuries.

Wounds and injuries, which cause loss of substance, must, in healing, give rise to leucoma, while slight mechanical violence may be followed by only temporary opacity. But of all these causes of loss of transparency, ulceration, and mechanical irritation from disease of the palpebral conjunctiva, are by far the most frequent and influential.

Treatment.

Treatment.—In cases of leucoma, as I have already remarked, it is impossible, by any remedial agencies, to remove the opacity. We may often do much towards restoring the patient's sight by means of an artificial pupil, but so far as the cornea is concerned, it is useless to attempt improvement. If the leucoma is of recent formation, it is very possible that the hazy rim of cornea which usually surrounds it will gradually disappear, and thus the extent of opacity diminish.

Artificial pupil in leucoma.

Nebulæ often get well.

In cases of nebulæ, time and nature will often effect a cure, especially among young people; but we may sometimes hasten the process by local applications. I usually prescribe, in the absence of irritation, a lotion containing one grain of iodine, and two of iodide of potassium, in an ounce of water, a few drops to be applied to the eye every morning. Should this lotion cause any irritation, it must be discontinued at once.

Iodine drops.

If the opacity is superficial, the cornea should be dusted over with calomel every other morning. The dilute red oxide of mercury ointment, weak astringent lotions, and in fact a multitude of so-called specifics, have been employed from time to time to cure these opacities of the cornea. If there is any irritation about the eye, the extract of belladonna may be smeared over the lids, and a light pad and bandage applied, so as to keep it at rest.

Calomel.

Ung. hyd. ox. rub.

Belladonna.

Opacities of the cornea arising from stains, such as that caused by nitrate of silver, can hardly be removed; a weak solution of cyanide of potassium has been recommended and may be tried for want of any more efficient plan of treatment. The opacities produced by deposits of carbonate of lead are more manageable. The patient must be placed under the influence of chloroform, and a stop speculum having been applied, so as to separate the lids, the eye is to be fixed with a pair of forceps, and the surgeon may then scrape off the deposit of carbonate of lead from the laminated tissue of the cornea; this can be managed either with an instrument that has been invented for the purpose, resembling a miniature goff-club, or a broad needle will answer the purpose equally well. A few drops of oil should be dropped into the eye after the deposit has been removed, and the lids kept closed with a pad and bandage for a few days.

Pot. cyan. for silver stains.

Lead deposits scraped off.

Leucoma, caused by chemical agents such as lime, or by mechanical injuries, which have destroyed a portion of the cornea, differs in no respect from that caused by ulceration.

Traumatic cases are frequently complicated with lesions of the lens, and their management will be more fully described under the head of cataract. In some very exceptional instances of central opacity of the cornea, it may be possible to give the incident rays of light an eccentric direction by means of prismatic glasses, and thus improve the patient's binocular vision. Under the heading of "artificial pupil," the reader will find rules relating to the formation of an artificial pupil in cases of opacity of the cornea.

Prismatic glasses.

Calcareous opacity

Before leaving this subject, I would refer to a form of opacity of the cornea described by Mr. Bowman.[*] It consists of a deposit of earthy matter on the surface of the cornea, which appears "very finely mottled with dark dots, some of which are only to be seen with a lens; its margins are shaded off rather abruptly, and the cornea beyond them is perfectly clear. The opacity has the appearance of occupying a superficial position and of being very slightly raised, but the surface reflects the light as brilliantly as other parts of the cornea." These opacities come on gradually, and are caused by a deposit of the salts of lime beneath the epithelium of the anterior layer of the cornea; they may be detached in the way already described in the case of carbonate of lead, and I have successfully removed the whole of the opaque mass in several instances. Deposits of this kind are very apt, however, to re-form, and often cause the patient incessant irritation and trouble; so much so, that in an instance recently in the hospital, I found it ultimately advisable to perform abscission, removing the entire cornea, on account of the protracted irritation produced.

to be removed.

Apt to re-form.

Tattooing cornea.

De Wecker not long since proposed to tattoo opaque spots in the cornea; and there can be no question as to the fact of this proceeding not only improving the appearance of the affected eye, but also diminishing the diffusion of light thrown on the retina in instances of opacity of the cornea. The operation of tattooing the cornea is performed as follows:—The lids having been separated with a speculum and the globe of the eye fixed, a number of small oblique punctures are made into the cornea with a sharp-pointed hollow spud, or needle, which has been dipped in fluid Indian ink. The speculum should be left in the eye till the ink has dried in the cornea. The operation may have to be repeated several times until the requisite amount of the white spot in the cornea has been dyed black.

CONICAL CORNEA.

CONICAL CORNEA consists in a thinning and bulging outwards of the whole or a part of the cornea, without loss of transparency. It sometimes appears as an abrupt cone, rising from the centre of the cornea, or the protuberance may be eccentric; but as a general rule, the whole of the cornea is involved, its centre forming the most prominent part of the cone (Fig. 26). It necessarily follows, under these circumstances, that the refraction of the rays of light on entering the eye is greatly increased, and they are brought to a focus anterior to the retina; the patient is therefore myopic. As a general rule, the disease appears between the ages of fifteen and twenty-five, but it may commence earlier, or as late as fifty years. It does not occur as a sequence of inflammation, but more commonly manifests itself in weak and sickly subjects, and generally progresses with equal rapidity in both eyes, though it may advance more rapidly in one than the other.*

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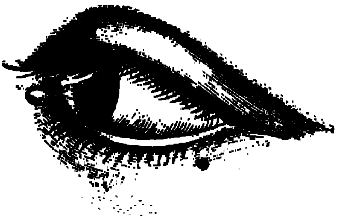
[*] "Lectures on the Parts Concerned in the Operations on the Eye," p. 117.

A transparent bulging.

FIG. 26.



Causes myopia.

In conical cornea, although the protuberance is often considerable, the cornea never gives way; it seems probable that as the laminated tissue becomes thinner it allows of a freer transudation of aqueous fluid through its substance than in health, and the intra-ocular pressure being thus relieved, there is not the same tendency that there otherwise would be, for the attenuated tissue to rupture, and give exit to the contents of the eyeball. There can be no doubt of the fact, that as the first step in this change, the laminated tissue of the cornea yields to the intra-ocular pressure, apparently from an inherent weakness in its fibrous structure; but that when the consequent attenuation has reached a certain limit, the balance is restored by exosmosis, and further distension prevented. These alterations in the resisting powers of the fibrous layers of the cornea advance most rapidly in its central portion, and degenerative changes occasionally occur in this situation, which render it more or less opaque; but with this exception, notwithstanding the very re-

Cornea never gives way.

Due to primary weakness of tissue.

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* *Ophthalmic Hospital Reports*, vol. ii. p. 157, 1859.

markable alteration of form which the cornea undergoes, it remains transparent.

Progress depends on state of nutrition.

The rapidity with which the disease progresses is variable; sometimes it makes rapid strides, and in other instances takes years to advance. These variations, however, will much depend on the state of the patient's general health; any cause which impairs the nutrition of the part, or which induces congestion of the choroid, and increased intra-ocular pressure, will tend to augment the protrusion. Excluding such disturbing causes, the disease will generally advance to a certain point, and then remain stationary for years, or it may be for life.

Symptoms.

Symptoms.—Besides the alteration in the appearance of the eye, conical cornea gives rise to impairment of vision, the degree of which depends very much upon the extent to which its curvature has been altered. In the early stages of the disease, the patient probably complains of slight, but gradually increasing, myopia, consequent on the increased refraction by the dioptric media. This defect may be corrected for a time by the use of concave glasses; but as the disease advances, not only is the refraction so much augmented that concave glasses cease to rectify the evil, but even before the disease has advanced to this stage, the altered curvature of the cornea, which is seldom equal in all its planes, gives rise to astigmatism. This again, if stationary, may be overcome by the use of cylindrical glasses. Should the degenerative changes continue to progress, opacity of the central portion of the cornea gradually supervenes, and the eye is destroyed.

Myopia.

Astigmatism.

It is seldom possible, by light directly thrown on the part, to appreciate the slight increase in the convexity of the cornea that marks the early stages of the disease; it is necessary to employ the lateral method of examination; the bulging forwards of the central portion of the cornea will then become distinctly visible in most instances. Should any doubt on the subject still exist, the ophthalmoscope without the convex lens in front of it may be used, the light from the instrument being thrown at different angles on the cornea; the side of the cone opposite the light will then appear darkened, or cast into the shade. This test is a very delicate one, and may be relied on when simple inspection fails to satisfy us.

Examine by lateral illumination,

or ophthalmoscope.

Treatment.—Our first and obvious duty will be to supply the patient, if practicable, with concave or cylindrical glasses, at an early stage of the disease, and thus prevent, as far as possible, all straining of the eyes, which tends to produce intra-ocular congestion and increased tension of the globe. In selecting glasses, the rules ordinarily applicable to cases of myopia and astigmatism hold good.

Treatment.

Glasses.

In the second place, we must do all in our power to improve or maintain the patient's general health. Individuals affected with conical cornea, as a general rule, are wanting in natural vigour, and often require tonics. Lastly, we may lessen the secretion of aqueous, in bad and advancing cases, by iridectomy, the upper section of the iris being removed; nor should this operation be long delayed if its full advantages are to be gained, because it is by lessening the amount of aqueous, and thereby diminishing the force which distends the cornea, that iridectomy proves serviceable. I do not assert that iridectomy will stop the progress of the affection, but in its early stages it affords us the best chance we have of checking it, especially in instances where the disease is making rapid progress.

Attend to general health.

Iridectomy.

Von Graefe recommends the following proceeding in cases of advancing conical cornea. One of his narrow-bladed cataract knives is to be thrust into the middle layer of the cornea, at the apex of the cone, and then passed out again, so that a small superficial flap may be made. The anterior chamber is not to be punctured, but only the exterior layers of the cornea raised and turned back, the flap thus formed being cut off at its base with a pair of scissors. If the cornea should by chance be punctured, the operation must be put off for a few days until the wound has healed. The day after the operation, the surface from which the flap of cornea has been removed is to be touched with a pencil of dilute nitrate of silver (nitrate of silver one part, nitrate of potash two parts), at first very lightly; this proceeding must be repeated every other day until an ulcer surrounded by a halo of infiltration is produced. The anterior chamber is then to be cautiously opened through the base of the ulcer with a blunt probe. The perforation is repeated daily for three or four days, and then the eye is bound up, and the ulcer allowed to heal. The result is the flattening of the excessive

V. Graefe's Operation.

curvature, and the formation of a leucoma at the part of the cornea most affected. It may be necessary to displace the pupil subsequently by means of iridectomy.* With reference to operations of this kind, it is almost unnecessary to remark that they should only be practised in extreme cases of conical cornea.

PELLUCID PROTRUSION OF CORNEA

SPHERICAL PELLUCID PROTRUSION OF THE CORNEA, or Dropsy of the Aqueous chamber, as it was formerly called, is a very insidious disease, usually following an attack of acute granular conjunctivitis, or keratitis; the toughness of the fibrous structure of the cornea, and therefore its power of resisting the intra-ocular pressure, having been diminished by disease, it slowly yields to the distending force, so as ultimately to bulge forward to a greater or less extent. The pathological condition we are now considering differs essentially from conical cornea in being preceded by some acute affection of, or injury to, the parts; sometimes it arises from deep-seated disease which has produced augmented intra-ocular pressure, and at the same time defective innervation of the cornea by involving the ciliary nerves. In some rare instances it appears to be a congenital affection: I know of a family at present, in which it exists to a most distressing extent, both sons and daughters being equally affected.

follows some acute affection.

Sometimes congenital.

Sclerotic involved.

In most cases of pellucid protrusion of the cornea, the sclerotic is also involved, the whole front of the globe bulging forwards; the breadth as well as the convexity of the swelling is thus augmented to such an extent, that it is often impossible for the lids to close over it. Ultimately the cornea may become opaque, and will probably be destroyed by progressive ulceration.

Iris affected.

In the early stages of this disease the functions of the iris are often impaired; it responds but slowly to the stimulus of light, and synechia subsequently forms between it and the lens. The patient seldom suffers from pain during the progress of this affection; but as the cornea becomes more prominent, he complains of increasing myopia, and experiences a sensation of distension in the orbit, particularly when he attempts to

Myopia.

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* "The Practitioner," vol. ii. p. 176. Mr. R. B. Carter on "Conical Cornea," *Lancet*, February 6th, 1869.

rotate the eye from one side to the other, the enlarged globe turning with difficulty in its socket; and in addition we shall have glaucomatous changes going on in the eye.

Treatment. **Most unsatisfactory.**

Treatment.—Cases of spherical protrusion of the cornea are almost hopeless ones. In the early stages of the disease, we may endeavour to stay its progress by tonics and similar means, hoping to improve the nutritive powers of the patient, and thus stop the local degeneration of the cornea and parts around it.

Iridectomy or paracentesis.

Iridectomy would be indicated in a rapidly advancing case; but I fear it would be attended with little, if any, permanent advantage. Repeated paracentesis of the cornea has been recommended, so as to keep the anterior chamber comparatively empty, and thus diminish the intra-ocular pressure.

Draw off aqueous slowly.

If we perform either paracentesis of the cornea, or iridectomy, in instances of this kind, it is advisable to draw off the aqueous slowly, so as to allow of a gradual diminution of the intra-ocular pressure; otherwise, the bloodvessels of the choroid, being most probably diseased, may suddenly give way, and destructive hæmorrhage occur, necessitating the excision of the globe. By drawing off the aqueous very slowly, we diminish this risk, the intra-ocular circulation adapting itself by degrees to the gradually diminishing tension of the eyeball.

Abscission.

Should the disease have advanced so far as to interfere with the action of the lids, the sight of the eye being destroyed, it will be better to excise the anterior half of the globe. This will be the more desirable if the other eye is not affected, which we may thus hope to save from sympathetic irritation.

WOUNDS AND INJURIES OF THE CORNEA.

INJURIES OF CORNEA.

INJURIES OF THE CORNEA, as Mr. Cooper[*] remarks, present themselves of every size, from the minute puncture of the surgeon's needle, which does not even cause the escape of the aqueous humour, to cuts and lacerations the most extensive; but there is no puncture or scratch, however slight, which is devoid of risk;

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[*] W. White Cooper on "Wounds and Injuries of the Eye," p. 98.

and no wound, within certain limits, from which the eye may not recover under favourable circumstances. The earlier the age the greater are the restorative powers, and if the patient is healthy, the less disposed is the eye to take on inflammation; even in advanced age, the recovery from operations is often surprising.

ABRASION.
A common accident.
Very painful.
Photophobia.

ABRASION OF THE CORNEA is by no means an uncommon accident; any foreign body, striking the surface of the cornea, may scratch off a portion of its epithelium. These corneal abrasions are often followed by acute pain in the eye, and sometimes, in neglected cases, by destructive inflammation. The patient usually comes to us with the eye firmly closed, suffering from considerable pain, lachrymation, and photophobia, and complaining of a sensation as if a foreign body were lodged in the eye.

Appearance of the part.

The moment the lids are opened a gush of tears takes place from the eye, and the palpebral and orbital portions of the conjunctiva will be found more or less congested. If the cornea be examined by oblique light, we may notice that the abraded portion has a glistening appearance, and is surrounded by a slight ridge, occasioned by the free margin of epithelial cells bordering the injured part. The outline of the excoriation is generally very irregular, and its size will of course vary according to the extent and nature of the injury.

Quickly repaired in health.
May suppurate.

A simple abrasion of the cornea, if it occurs in a healthy person, and is properly treated, generally heals in the course of three or four days; the epithelium is re-formed, and the parts assume their normal condition. But if the patient be out of health at the time of the injury, or if the case be carelessly treated, simple abrasion may induce troublesome keratitis even leading to ulceration or abscess of the cornea.

Treatment.
Oil.
Belladonna.
Rest.

Treatment.—In a case of abrasion of the surface of the cornea, it is well to open the lids carefully and drop some olive oil into the eye, then smear the extract of belladonna over the lids, and lastly apply a pad of cotton-wool and a bandage, so as to keep the parts at rest for twenty-four hours. If after this the patient continues to suffer from pain, it will be advisable to drop a solution of atropine into the eye, and order poppy-head fomentations to be employed frequently, the pad and bandage being applied in the interim.

After an accident of this kind, if the irritation has run on to inflammation or ulceration, we shall have to treat the case upon precisely the same principles as those I have already laid down, when discussing the subjects of keratitis and ulceration of the cornea. In abrasion of the cornea no irritant lotion should on any account be used; rest is the chief means we must employ, and if this be attained, in most cases the epithelial cells will very soon be reproduced, and the functions of the eye restored.

Contusions rare.

Contusions of the Cornea resulting from direct injury are uncommon, on account of the rapidity with which the lids close and prevent the impact of a foreign body upon the eye. Nevertheless, cases of contusion of the cornea do occur, and in old and sickly people are at times followed by rapidly-advancing destructive changes in the part, independently of complications, such as detachment of the retina or choroid, which are likely to take place under the same circumstances. After contusion, the cornea may rapidly assume a hazy appearance, the patient suffering great pain in the eye, and the conjunctiva becomes deeply congested; in unfavourable cases, these changes may run on into suppurative keratitis, in spite of our best efforts to prevent it; and if necrosis of the cornea commences under these circumstances, it will almost certainly terminate in the entire destruction of the eye.

May be followed by suppuration.

The cornea itself is seldom ruptured from a blow, although the sclerotic near the margin of the cornea may be torn open by direct violence.*

Penetrating Wounds.

Heal well if edges fit.

Penetrating Wounds of the Cornea, provided they are not complicated with prolapse of the iris, will, if their edges fall into accurate apposition, usually heal very rapidly. On the other hand, wounds with jagged edges, or those accompanied with loss of substance, heal with difficulty; and as a general rule, an opaque cicatrix remains to mark their position on the cornea, and materially interferes with the patient's sight if it be situated in the axis of vision.

Prolapse of iris may occur.

The complication which principally interferes with the healing of wounds of the cornea is a prolapse of the iris, preventing the apposition of the edges of the generally applicable in these cases, is to perform an iridectomy, removing all the protruded portion of the iris, and thus preventing the chance of a further prolapse, or the ill consequences arising from the iris becoming involved in the cicatrix. But in performing an iridectomy under these circumstances, we must bear in mind the fact, that there is no anterior chamber, the lens being thrust against the posterior surface of the cornea; to make an iridectomy, therefore, the patient must be placed under chloroform so as to relax the muscles, no stop speculum can be used, and the section in the cornea must be performed with a very narrow-bladed knife, which can be made to transfix the margin of the cornea only, thus keeping clear of the lens.

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* W. White Cooper on "Wounds and Injuries of the Eye, p. 192.

FOREIGN BODIES

cause much irritation.

FOREIGN BODIES IN THE CORNEA.—It frequently happens that particles of dust, bits of coal, straw, and such like substances find their way into the eye, and becoming fixed in the epithelial layers of the cornea, excite considerable irritation and pain, intolerance of light, and profuse lachrymation. There is generally but little difficulty in detecting the presence of a foreign body on the cornea, especially if the part be examined by the lateral method of illumination; and the sooner an offending particle is removed from this situation the better, for the patient by constantly rubbing at the lid, is apt to drive the offending particle deeper into the cornea, and it may then give rise to severe inflammation of the eye.

Easily removed if superficial.

Stains may be left.

When consulted in cases of this kind, the surgeon should seat his patient in front of a good light, and standing behind him, with the aid of an assistant, he should keep the eyelids wide open, the patient being at the same time directed to look steadily forwards; with a small spud or cataract needle he may then pick the offending particle off the cornea. If it happens to have been a little bit of iron, or coal, or in fact any substance likely to stain the cornea, although the particle is detached, the discoloration may remain, and we should not attempt its removal; it will wear away in the course of a few days, as new epithelial cells are formed.

It often happens, in cases of this kind, that before we see the patient, the foreign substance has been lodged in the eye for some days, and has set up so much irritation that it is utterly impossible for the patient to hold his eye steady for an instant, in order that the surgeon may remove it. Under these circumstances, it is well to allow the patient to inhale a little chloroform or æther, and the operation may then be completed without any difficulty. If there should be any objection to chloroform, better apply a stop speculum to the eye, and having fixed the eyeball with a pair of forceps, we can command the eye and quickly effect our object. After the removal of the foreign particle from the cornea, a few drops of castor-oil may be dropped into the eye, and the lids kept closed for twenty-four hours with a pad and bandage.

Apply oil, pad and bandage.

Cases of Impaction.—The foreign body may, however, strike the cornea with sufficient force to be driven deeply into the laminated tissue, and it then gives rise to the most severe irritation, and it may be, inflammation of the eye. The hyper-action thus induced may become localized around the offending particle, and suppuration taking place, it is gradually loosened from its position by the disintegration of the surrounding tissue, and so cast out of the eye. An ulcer thus formed usually heals up tolerably quickly, a small nebulous spot alone remaining to indicate the position the foreign body occupied.

If deep, may escape by suppuration,

In other cases no such localization of the inflammation occurs around the offending particle, but spreading from the seat of injury, it gradually involves the whole cornea, and ultimately the deeper tissues of the eye, terminating in general inflammation of the globe.

or cause an abscess.

When called to attend a case where a foreign body has become impacted in the cornea, our first duty is obviously to remove it as soon as possible. If the eye is painful and irritable, it will be advisable to administer chloroform; and the point of a cataract needle, or spatula, being inserted beneath the foreign body, it is to be lifted from its bed. It is surprising how firmly particles of iron or dust may become wedged into the laminated tissue, and without the aid of chloroform, it often requires the greatest patience on the part of both surgeon and patient to dislodge them. After removal, the eyelids must be kept closed for a day or two with a pad and bandage.

Remove at once with needle.

Often firmly fixed.

If the foreign body has given rise to abscess or suppuration of the cornea, the case must be treated upon the principles already laid down with reference to these affections (p. 254).

Seldom become encysted.

It does not often happen that foreign bodies become encysted in the cornea, but occasionally we meet with instances of the kind. Thus, a grain of gunpowder, or some such substance, becomes imbedded in the cornea, and probably gives rise to some slight irritation in the first instance; this gradually subsides, and the particle remains encysted, causing no further inconvenience. Under these circumstances it would hardly be wise to attempt its removal; but these are exceptional cases, and by no means invalidate the general rule, that a foreign body should be extracted from the cornea as soon as possible.

Perforation of cornea.

Wounds of iris or lens.

Prognosis from size and position.

Cases of Perforation.—We sometimes meet with instances in which a chip of steel, or other hard substance, has been driven against the cornea with sufficient force to perforate it, its inner extremity wounding, perhaps, the iris and lens. It is upon a consideration of the size and position of the particle, and the complications to which it may give rise, that our prognosis and treatment must be based. If the foreign body is a large one, it follows as a general rule, that it will excite much more irritation and inflammation in the eye than a smaller one would do. So again with regard to its position—if in the axis of vision it will almost certainly injure the cornea, to such an extent as to interfere with the subsequent perfection of vision.

From escape of aqueous.

So far the features of such a case are sufficiently obvious; but it requires a certain amount of experience, and a careful study of the parts, to determine if a foreign body, which has perforated the cornea towards its circumference, has wounded the iris or lens. In most cases where the cornea is thus transfixed, the aqueous escapes, and the iris and lens are thrust against the inner extremity of the foreign body, and thus placed in imminent peril.

Examine under chloroform

by transmitted light.

The intense pain, intolerance of light, and lachrymation to which these more serious injuries of the cornea give rise, render it necessary to administer chloroform before making our examination, in order that we may be enabled to inspect the parts thoroughly, as well as to assist us in removing the foreign body. The lids having been separated we must examine the seat of the injury by transmitted light; the position and relations of the foreign body are thus to be carefully studied. If the iris is in its normal position, being well away from the cornea, it indicates the fact that the aqueous humour still fills the anterior chamber, and that the inner extremity of the foreign body, unless it be of some considerable length, may not have wounded the iris or lens. Under these circumstances the case will be a comparatively simple one, provided no deep-seated inflammation of the eye has been excited. On the other hand, we may discover or suspect, from the escape of aqueous or the depth of the penetration, that the iris or lens has been wounded. If the iris has suffered, the case may be complicated by iritis; and if the capsule of the lens has been injured, a traumatic cataract will add still further to the difficulties we shall have to contend with.

If simple, remove with forceps.

Supposing, however, that both the iris and lens have escaped injury; having the patient still under the influence of chloroform, we may generally lay hold of the foreign body with a pair of forceps, and remove it from the eye without difficulty.

If deep, employ a needle.

But if from the action of the eyelids, or the patient's endeavours to rub the substance out of the eye, he has driven its outer extremity inwards, and flush with the cornea, or it may be deeply into its laminated tissue, it will then be impossible to take hold of it with a pair of forceps, and any forcible attempts to do so would probably drive it completely into the anterior chamber. It is advisable, under these circumstances, to enlarge the wound in the cornea, and then seize hold of the foreign body and remove it; it has been recommended in cases of this description to pass a broad needle through the margin of the cornea, the flat blade of the instrument being inserted beneath the inner extremity of the foreign body; the latter may thus be pushed outwards, till its projecting end can be taken hold of with a pair of forceps, and extracted from the eye.

Atropine.

Pad and bandage.

A solution of atropine should subsequently be dropped into the eye, three or four times a day, so as, if possible, to keep the iris away from the wound in the cornea, and a pad and bandage should be carefully applied. If the eye is much inflamed, cold compresses may with advantage be used, and opium must be administered internally, so as to allay the irritation in the part. Leeches will be necessary if the inflammation runs high.

If in anterior chamber, use other means.

If on examining the eye we find the foreign body has wounded the iris or lens, but can still be withdrawn from the cornea, we shall, of course, lose no time in removing it; but if it has fairly passed through the cornea, and fallen down into the lower part of the anterior chamber, or is seen sticking in the iris or lens, we can no longer hope to seize it with the forceps; having once passed through the cornea the elastic lamina closes over it, and defeats all our attempts to get at it in this way, and a different method must be employed. The management of these cases will be found described under the head of wounds of the iris and lens, the corneal injury being a matter of very secondary importance.

Arcus Senilis.

Appearance of.

Senile Degeneration of the Cornea.—This condition of the cornea is characterized by the presence of the *arcus senilis* or white margin, which Mr. Canton describes as follows:—"The arcus senilis, if closely examined, will be found to be composed of two parts, the outer having a greyish white, or dusky tint, the inner one being milky in colour. These are separated from each other by a clear, unaffected line of cornea, and through this the iris can be distinctly seen."*

Progress.

This alteration in the margin of the cornea usually commences in its upper section, and in both eyes at the same time; subsequently the lower portion is similarly affected, so that the eye then presents two white crescents, an upper and a lower one; they gradually advance, and ultimately coalesce, and the cornea is then surrounded by a whitish band as above described. This band usually extends only a short distance from the margin of the cornea, but in some instances it encroaches on the more central parts, and may involve a very considerable portion of the cornea, but such cases are rare.

This formation is not to be confounded with the grey line which corresponds to the border of the sclerotic;

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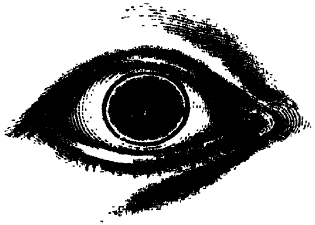
* E. Canton on "The Arcus Senilis, or Fatty Degeneration of the Cornea," p. 6.

where it is bevelled off to overlap the cornea: the true arcus senilis presents precisely the appearances described by Mr. Canton and depends upon fatty degeneration of the cornea, its transparent structure being converted into a semi-opaque band, of the extent and configuration depicted in Fig. 27.

Due to fatty degeneration

FIG. 27.



from age

As a general rule, the arcus does not appear before a man has reached the age of forty-five or fifty, but it may come on in younger people; when it does so, it may be taken as an indication of a constitutional tendency to fatty degeneration of the tissues. There can be no doubt that the arcus senilis is hereditary; that is, the gouty or other diathesis upon which it depends passes from parent to child, and with it the tendency to early fatty degeneration of the cornea, the muscular tissue of the heart, and other organs of the body.

or hereditary tendency.

I am not aware of a single instance in which this disease has advanced so far towards the centre of the cornea as to interfere with the perfection of vision. I cannot say that in operating for cataract, the presence of an arcus senilis influences me in the selection of one or other of the various modes of removing the lens; I have frequently performed the flap extraction with the most favourable results, although an extensive arcus senilis has been present.

Does not interfere with vision,

or operations.

Instances have been recorded of an arcus senilis disappearing under a course of treatment calculated to increase the vigour of mind and body, among those whose constitutions have been impaired from overwork, ill-health, and other depressing influences.

LEPROUS AFFECTIONS OF THE CORNEA.—Among the natives of India, and in fact among all classes affected with leprosy, it often happens that both corneas become nebulous, the opacity commencing at the extreme margin of the cornea and extending year by year towards the axis of vision: vessels may from an early stage of the disease be seen protruding from the subconjunctival zone into the cornea, and from time to time these vessels become much congested, the hyperæmia lasts for a month or two and then subsides; but after each attack of this kind the opacity of the cornea increases both in extent and density, and so the patient's sight is slowly but surely lost for all practical purposes.* Changes in the transparency of the cornea such as I have above described, are due to the growth of leprous elements in the tissue of the cornea, and consequently we can only hope to influence the condition of the eye by acting on the primary cause of the disease. I have seen so many leprous patients improve under a long continued course of tonics, combined with arsenic, change of climate, and a generous dietary, that I am by no means disposed to abandon cases of leprous opacity of the cornea to their fate. We cannot cure the disease, but I am persuaded we can often stop its progress for years, if not for life, and thus preserve the eye among other organs of the body from destruction.

Leprous tubers of the cornea are seldom met with unless similar growths are seen springing from the iris. They commence as small pale elevations situated on the margin of the cornea; as the little tuber grows it becomes vascular, and gradually extends itself over the surface of the cornea. Both eyes are, as a rule, attacked, and the tubers are placed symmetrically on corresponding spots of the cornea. The tubers take years to grow, but nevertheless they surely and gradually increase in size until they may entirely cover the cornea. As far as my experience goes treatment is of little avail in this form of leprosy; an eye once affected by tuberous growths will, in spite of all we can do, gradually be destroyed. Nor is it of any advantage to excise these leprous tubers—they are certain to grow again, even if the base of the excised tuber is freely attacked with chloride of lime. Leprous tuber of the iris and cornea is, without exception, one of the least hopeful affections of the eye we have to deal with; the only consolation in cases of the kind is, that the progress of the malady is a very protracted one.

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* Some years since, I sent a patient suffering from leprous disease of the cornea to Mr. J. Hutchinson, and from this patient Plate XXIX. was drawn of the series of Chromolithographs of Diseases of the Skin, published by the New Sydenham Society.

CHAPTER IX.

DISEASES OF THE IRIS.

Hyperæmia—Plastic, serous, parenchymatous Iritis—Treatment—Corelysis in Synechia—Traumatic Iritis—Wounds of the iris—Detachment—Tumours—Mydriasis—Myosis—Tremulous iris—Hippus—Artificial pupil—Excision of iris—Iridesis—Iridectomy—Changes in the aqueous—Foreign bodies in the anterior chamber—Irido-choroiditis.

HYPERÆMIA AND INFLAMMATION.

In commencing the consideration of the diseases of the iris, it may be well briefly to recall the different elements of its healthy structure, which may severally become the subjects of pathological change.

Colour of healthy iris.

The colour of the iris, depending as it does upon the amount and tint of the particles contained in its pigment cells, naturally varies in different individuals. As a general rule, the irides are of the same colour, but we occasionally meet with instances of a congenital difference in this respect, although they may be otherwise perfectly healthy.

Its texture.

Whatever the colour of the healthy iris, it has a brilliant, shining, fibrous aspect, and any alterations in its textural character are symptomatic of disease, although the change may be so slight, that it can only be appreciated by comparing the diseased with the healthy eye.

Form and mobility of pupil.

The state of the pupil, again, is an important element for consideration in diseases of the iris and deeper structures. In the healthy eye the surfaces of the iris and its pupillary margin are quite free in the aqueous humour; the pupil has a circular form and a wide range of motion, quickly responding to every change in the degree of illumination (see p. 18); but it frequently happens that, from inflammatory or other causes, adhesions form among the fibres of the iris, or

How impaired in disease.

between it and the capsule of the lens. Under these circumstances the action of its contractile elements is mechanically impeded, the mobility of the pupil impaired, and its circular form distorted.

But defective action of the pupil may arise from faulty innervation. Thus, affections of the retina, or of the choroid by involving the long ciliary nerves, will influence the sensibility of the iris. Alterations, therefore, in the activity of the pupil, are not necessarily pathognomonic of disease of the fibrous structures of the iris, for they may depend upon more remote influences, into which it would be foreign to my purpose to inquire at present.

HYPERÆMIA rarely idiopathic.

HYPERÆMIA OF THE IRIS is the first departure from the healthy state which requires our attention, when occupied with the pathology of the iris; not that it often occurs as an independent affection, but it is a sufficiently constant feature of several maladies to deserve consideration. Thus, hyperæmia is occasionally met with as a result of injuries or wounds involving the cornea; but it is more often seen in the early stages of iritis, or congestion of the choroid; and is not unfrequently described as chronic iritis.

"Sclerotic zone."

Symptoms.—This condition of hyperæmia, from whatever cause it arises, is always characterized by the appearance of a rosy zone of finely injected vessels, at the junction of the cornea and sclerotic; the extent and depth of coloration of this zone vary with the progress of the disease. It is important to notice that in these cases the cornea remains perfectly transparent, so that there can be no mistaking this sclerotic or subconjunctival zone of small parallel vessels, in hyperæmia of the iris, for a symptom of keratitis.

Congestion of iris.

On examining the hyperæmic iris by transmitted light, we shall be able distinctly to trace the distended vessels coursing over its surface. The fibrous elements of the iris remain, as a rule, unaltered in colour. In some few instances, however, after long-continued hyperæmia, changes take place in the pigment-cells of the iris, similar to those noticed under analogous circumstances in the choroid; they become of a darker colour and shrink up. These alterations usually commence at the margin of the pupil, in the uvea covering the contractile fibres of the iris, which then pre-

Colour rarely altered.

sent an uneven and spotted appearance, small dark excrescences projecting from them into the pupil. The pupil responds but slowly to the stimulus of light or to weak mydriatics; but even after long-continued hyperæmia, the contractile elements of the iris seldom become disorganized; and no sooner does the congestion subside, than it again actively performs its functions.

Pupil sluggish.

Vision dim after sunset.

The patient seldom complains of pain in the eye, but of more or less dimness of vision, which is most marked after sunset. This symptom of hyperæmia of the iris depends on the impairment of its functions, caused by the pressure of its congested vessels on the contractile and nervous elements of the iris, the consequence of which is, that the pupil fails to dilate after nightfall, thus preventing a sufficiency of light from reaching the retina to produce distinct vision. During the day the patient sees tolerably well, for these cases of hyperæmia differ from iritis, in that there is no turbidity of the aqueous.

Passes into iritis.

Congestion of the iris is so frequently associated with, or merges into iritis, that I shall describe the treatment to be adopted in this form of disease when considering that of inflammation of the iris.

Iritis.

IRITIS, OR INFLAMMATION OF THE IRIS.—I propose describing iritis under three heads: first, the simple or plastic iritis; secondly, the serous; and lastly, the parenchymatous or suppurative iritis.* Inflammation of the iris is accompanied by certain symptoms common to all forms of the disease, and which it will be convenient to describe under distinct headings, so as to save the necessity for recapitulation when giving the characteristic features of each variety.

Symptoms common to all forms.

Pain in the affected eye is a constant symptom of

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* I have adopted this nomenclature, because it seems to me, on pathological grounds, to be sounder than that employed by some English surgeons, such as rheumatic iritis, syphilitic, and so on. But beyond this, the nomenclature is that of M. Wecker, Von Graefe, and the leading Continental authorities; and it is desirable to promote as much unanimity as possible in the profession on these matters. Lastly, so far from sacrificing principles or views which I deem to be important, I feel that my subject is simplified and best explained by the arrangement here employed.

Pain constant, severity variable;

iritis, but varies considerably in degree in different cases. In many instances the patient complains of only slight uneasiness, extending from the eye over the corresponding side of the forehead, whereas in others the pain is excruciating, and of a throbbing, lancinating character, involving not only the affected eye, but the side of the head and face. Under any circumstances the pain is intermittent, usually increasing towards evening, and gradually growing worse as the night advances. In other cases, in which the iris is not much swollen, nor the intra-ocular pressure greatly increased, the patient will hardly notice this symptom; it is always, however, increased when pressure is made on the eyeball.

Intermittent.

Zone of sclerotic vessels.

Sclerotic Zone.—A rosy zone of parallel congested subconjunctival vessels, invariably surrounds the junction of the cornea and sclerotic in this disease; hyperæmia of the iris must in fact exist in instances of iritis, and consequently congestion of this subconjunctival zone of vessels, since they anastomosewith those of the iris and choroid. The amount of the subconjunctival congestion will of course vary with the severity and stage of the inflammation, and in some cases may be concealed to a great extent by the injected and chemosed conjunctiva. Ultimately, as the iritis passes off, and the balance of the circulation is restored, the zone of vessels gradually disappears, and the sclerotic assumes its normal appearance.

Dim vision, from turbid aqueous

and post-corneal haze.

Dimness of sight is another symptom of iritis; it depends in the first instance upon turbidity of the aqueous, more than on alterations in the iris. Another cause of the haziness of vision consists in the changes which take place in the epithelium of the posterior elastic lamina of the cornea, and which are best detected by the lateral method of examination. These cells often present a hazy appearance, similar to that of the anterior layers of the cornea in keratitis. In instances of this kind, flakes of degenerated and detached epithelium may by means of transmitted light sometimes be seen floating about in the aqueous. In the further progress of iritis, bands of adhesion form between the iris and the capsule of the lens, giving rise to the condition known as synechia. In this way the pupil is sometimes closed, and the sight is consequently very imperfect. If, however, the patient's vision is much affected and the pupil is not closed, we may with reason suspect that the ciliary body and vitreous have become involved; in instances of this description there is usually tenderness on pressure made over the region of the ciliary body; and the power of accommodation is also affected.

Change of colour in iris.

Changes in the Colour and Texture of the Iris are noticeable in all cases of iritis; a blue or grey iris becoming more or less greenish, a green iris yellowish green, and a dark brown iris of a reddish hue. Its brilliant fibrous aspect is also destroyed, being exchanged for a confused and muddy appearance. These alterations are rendered more apparent by comparing the diseased with the healthy eye (provided only one eye is affected); but under any circumstances, the change in the colour and brilliancy of the iris is unmistakeable in all instances of inflammation, and is due partly to alteration in the fibrous structure of the iris, and partly to turbidity of the aqueous humour.

Pupil sluggish,

Alteration in the Mobility and Form of the Pupil.—The congested state of the vessels, together with the serous effusion that occurs in the early stages of inflammation of the iris, necessarily impair the functions of the contractile elements of the iris, and consequently its mobility; hence a defective response of the iris to the stimulus of light is an early symptom of iritis. Subsequently, as adhesions form between the iris and the lens, they not only impede the action of the former, but, when under the influence of atropine, the pupil assumes an irregular figure, or, it may be, is unable to dilate at all, being completely closed by organized bands of neo-plastic tissue. From the commencement, therefore, and throughout the course of an attack of inflammation, the iris responds but slowly and imperfectly to the stimulus of light or to mydriatics.

or irregular from synechia.

Intolerance of light.

Intolerance of light and Lachrymation are symptoms so frequently met with in iris, that they may be considered as being common to all its forms. In chronic or subacute cases, they may be hardly noticeable, whereas in the active stages of the more acute forms of the disease, the patient complains bitterly of the exacerbation of pain which he experiences the instant he approaches the light, and is perpetually engaged in wiping away the tears that flow down over his cheek.

Congested conjunctiva.

Congestion of the conjunctiva is always present to some extent in iritis, and in many instances its vessels are so deeply injected, that it is well nigh impossible to distinguish the sclerotic zone surrounding the cornea. In these cases, if the posterior layers of the cornea are also affected, the condition of the iris, which is the real centre of disease, is apt to be overlooked. Any doubts that may exist as to the nature of the affection may be at once cleared up by applying a few drops of solution of atropine to the eye; the irregular way in which the pupil dilates will then be apparent.

Atropine as a test.

Increased tension.

Increased Tension of the eyeball is present in the serous form of iritis, and is one of the chief causes of the pain from which many patients suffer; for no sooner is the intra-ocular pressure removed by puncturing the cornea, and allowing the aqueous to escape, than the patient experiences instantaneous relief.

Constitutional Symptoms.—Complications of this kind are sometimes met with in cases of iritis, the patient complaining of feverishness, and very rarely of troublesome vomiting, the result of sympathetic irritation. Many instances of iritis, however, run their course without the manifestation of any such symptoms, and under any circumstances they are of trivial importance in comparison with the state of the eye.

Fever.

PLASTIC IRITIS.

SIMPLE OR PLASTIC IRITIS.—(Fig. 2, Plate III.)—This form of inflammation is marked by new formations in the iris; proliferation commences in the connective tissue cells of its stroma, and this increased cell formation, together with that arising from elements directly emanating from the blood, cause the iris to swell; this swelling of the iris is increased by serous effusion into its tissue. The characteristic feature of simple or plastic iritis is, that the neoplastic elements produced, both on the surface and in the substance of the iris, tend to become developed into a kind of pseudo-membrane; bands of adhesion are thus formed between the iris and capsule of the lens (synechia), and in the contractile tissue of the iris itself.

Neo-plastic formations.

Plastic iritis is frequently met with among persons suffering from rheumatism, and consequently it has often been described as rheumatic iritis; this inference, however, is hardly correct, and is likely to lead to errors in practice; for nothing is more common than to meet with instances of this affection occurring among individuals who are perfectly free from rheumatism. In the case of lepers, for instance, plastic iritis is of common occurrence, and also as a result of wounds or injuries of the eye.

Not limited to rheumatic subjects.

Under very favourable circumstances, this form of disease may run its course in from ten to fifteen days, and then gradually disappear. Instances of this kind are, however, exceptional, unless the patient has been brought under treatment at an early stage of the affection. The majority of cases of plastic iritis, if left to nature, terminate in synechia: slight adhesions form in the first instance between the pupillary margin of the iris and the lens, which, however, are sufficient to tie the iris firmly down to the capsule at one or more points. Every time that the pupil dilates or contracts, these tags of adhesion pull on the iris, thus keeping up a constant state of irritation and disturbance in the part, which ultimately induces a fresh attack of inflammation: more extensive adhesions then form, until, after repeated attacks of this kind, the iris becomes firmly bound down to the lens. Degenerative changes then take place in the fibrous structure of the iris, which ultimately becomes atrophied. Unfortunately, the mischief that occurs under these circumstances does not stop here; the communication between the anterior and posterior chambers of the eye being closed, an abnormal collection of fluid takes place behind the iris, which exercises, on the deeper structures of the eye, an injurious pressure, too often terminating in atrophy of the globe.*

Synechia and its effects.

Atrophy of iris.

Symptoms.—As a general rule, the zone of subconjunctival vessels surrounding the circumference of the cornea is well marked in cases of plastic iritis, the hyperæmia of the conjunctiva not being sufficiently great to completely hide it. It was formerly supposed that the whitish grey band surrounding the

Pericorneal injection.

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* A. Von Graefe, "On Iridectomy in Exclusion of the Pupil," p. 257. (New Sydenham Society.)

"Arthritic ring."

cornea, and situated internally to the zone of subconjunctival vessels, was a characteristic feature of the so-called rheumatic iritis. This band, however, depends simply upon the anatomical relations of the parts, the sclerotic overlapping the bevelled margin of the cornea in this situation : and though well seen in many cases of iritis, is a symptom of no importance.

Mobility of iris impaired.

In the early stages of plastic iritis, the mobility of the iris is affected, its free margin appears to be swollen and thickened, its fibrous structure loses its distinctness, and its colour is likewise altered. The production of neo-plastic formations varies in quantity in different cases: commencing in the stroma of the iris, it may add to the uniformly hazy, swollen condition of that structure, but is otherwise not distinguishable: in other instances the neo-plastic growths form small papillary excrescences on the surface of the iris, particularly at its pupillary margin: if numerous, these run into one another, and reaching over the pupil cover the centre of the capsule with a pseudo-membrane; under any circumstances they are very apt to form adhesions between the margin of the pupil and the capsule of the lens. These papillary excrescences of plastic iritis, are often mere specks which can hardly be seen by the unaided eye, particularly when the iris, as in the case of the natives of India, contains an abundance of pigment cells ; so that we may not be able to detect their presence in the living subject by simple inspection, but only by the changes effected in the appearance and activity of the iris, and in this respect the simple form of plastic iritis differs from the parenchymatous variety.

Neo-plastic matter not always obvious.

Pain uncertain.

The amount of pain from which a patient affected with this form of iritis suffers, is by no means constant; in some cases, it is not a prominent symptom, whereas in others it is most excruciating, extending from the affected eye over the temple and side of the face, and almost always increasing in intensity towards evening, and growing gradually worse as the night advances.

SEROUS IRITIS.

SEROUS IRITIS.*—In place of the neuro-plastic formations which characterize the last described form of iritis, in that now under consideration a serous exudation takes place from the vessels of the iris, which, accumulating in the anterior chamber, pushes the iris backwards; so that in well-marked cases of serous iritis, the iris appears to be further away from the cornea than in health, the depth of the anterior chamber being apparently increased. The functions of the iris are impaired, and it responds but slowly to the stimulus of light; except in some chronic cases, however, the pupil, when it dilates, does so regularly, there being no synechia in serous iritis to impede the action of its contractile fibres. In this respect, therefore, there is a marked difference between serous and plastic iritis. In the more advanced stages of the disease, the accumulation of serous fluid in the chambers of the eye causes such an amount of increased intra-ocular pressure, that its effects begin to tell on the choroid and long ciliary nerves; and the innervation of the iris being thus impaired, it not only ceases to respond to the stimulus of light, but the most powerful mydriatics may be unable to effect it.

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* Formerly described as "aquo-capsulitis." One form of aquo-capsulitis, in which the pathological changes are most apparent on the posterior surface of the cornea, has been already

Serous effusion into ant. chamber.

Pupil slow, but regular.

No synechia.

Inactive at last.

Symptoms.—Serous iritis excites no urgent symptom in its early stages; the zone of sclerotic vessels may be only slightly injected, and the conjunctiva unaffected; the disease is not unlikely, therefore, to be disregarded until it has effected irreparable changes in the deeper structures of the eye, or has merged into a combined form of serous and plastic iritis of a very dangerous character. In the latter case, the neo-plastic formations binding the iris down to the lens, effectually retain the serous effusion poured out into the posterior chamber, which is certain, in its turn, to induce changes in the retina and choroid.

Symptoms obscure in early stages.

Attacks of serous iritis are apt to recur: at first they are but slight, and of comparatively short duration, lasting probably from three weeks to a month, and then gradually passing away; and it may be some time before another attack, generally of increased severity, comes on.

Recurring attacks.

The intra-ocular pressure, which is hardly augmented in the early stages of the disease, becomes a more pro-

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described under keratitis pun[illegible] In that now referred to the iris is principally affected.

Slow increase of tension.

minent feature in each successive attack; the tension of the eyeball, however, increases so gradually, that the parts have time to adapt themselves to the distending force, and consequently the pain, though often severe, is not of so excruciating a character as that noticed in instances of acute glaucoma.

Dim vision.

Dimness of vision is always an early complication of serous iritis,[*] and depends on turbidity of the aqueous, which frequently assumes an appearance as though small particles of finely powdered chalk had been suspended in it, and of course prevents many of the rays of light, which would otherwise reach the retina, from arriving at their destination. This state of things is augmented by a semi-opaque condition of the epithelial cells, lining the posterior elastic lamina of the cornea; we have, in fact, very much the condition of the parts described in keratitis punctata, or mottled cornea, in the last chapter, with the serious addition of iritis. The diseased epithelial cells drop off from the cornea after a time, and may then be seen as small white particles floating about in the turbid aqueous. The corneal haze and muddy aqueous, which are thus produced, tend to conceal the condition of the iris, and render the diagnosis of this affection in its early stages somewhat obscure.

Posterior keratitis.

Turbid aqueous.

PARENCHYMATOUS IRITIS.

PARENCHYMATOUS IRITIS.—The characteristic feature of this form of inflammation is, that the morbid action going on in the part leads to the formation of well-defined nodular masses, consisting of a finely granular or striated matrix, containing elementary capillaries, and nuclei in abundance, and often much pigment;[†] they occupy the surface of the iris at one or more points. These excrescences vary in size, in some instances being as small as a pin's head: whereas in others they cover the greater portion of the iris, and bulge forwards, so as to touch the cornea. In the early stages of the disease, they are usually of a reddish-brown colour, subsequently they assume a yellowish tinge, and then look very like collections of pus. They may either become absorbed or suppurate: in

Neo-plastic out-growths.

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[*] "Iconographie Ophthalmologique," par J. Sichel, p. 12.

[†] "Archiv. f. Ophth.," Bd. viii. p. 288.

the former case the iris may return to its normal condition, its contractile tissue being apparently uninjured; but we seldom meet with a case of this kind: more often cicatrices form in the iris, and extensive synechia is the result of this form of inflammation. On the other hand, should the new formations of parenchymatous iritis suppurate, the pus, gravitating to the lower part of the anterior chamber, forms an *hypopion*.

may suppurate, or end in synechia.

Hypopion.

The breaking down of the nodular masses is not, however, the exclusive source of pus-like matter in iritis: sometimes the products of cell proliferation on the surface of the iris have from the first the characters of pus. In other cases, the posterior elastic lamina of the cornea contributes to its formation; and, indeed, hypopion is more often the result of corneal than iritic affections.

Often syphilitic;

Parenchymatous iritis may often be traced to the effects of either primary or inherited syphilis; syphilitic iritis is, in fact, the most familiar variety of the parenchymatous affection. In the hereditary form the disease usually manifests itself before the little patient is more than a few months old.*

"Gummy" character.

In all instances in which parenchymatous iritis arises from syphilis, we may expect to find the cellular excrescences particularly well defined. The nodules observed on the iris under these circumstances are neither more nor less than "gummy tumours," similar to those met with in other parts of the body, as a result of syphilis.† Our diagnosis will of course be confirmed, in instances of this description, by the history of the case and the existence of constitutional symptoms, but still the condition of the iris alone will lead us at once to entertain suspicions as to the origin of the disease.

Other causes.

It does not follow, however, that parenchymatous iritis may not result from other causes than syphilis. In fact, we meet with cases of the kind arising from operations or injuries involving the iris, and from ill-defined causes. Moreover, a syphilitic taint may, without doubt, induce the plastic or serous form of inflammation, as well as the parenchymatous. It is a matter of some importance, therefore, to be careful how we employ the term syphilitic iritis, as it is apt to give rise to errors in regard to the treatment of the disease. The syphilitic character of an iritis can only be determined from the positive proof of the existence of constitutional syphilis.*

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* "Syphilitic Diseases of the Eye and Ear," by J. Hutchinson. p. 18.

† The gummy nature of these nodules, at first conjectured by Virchow, has been confirmed by the observations of Colberg. Arch. für Augenheilk., t. viii. A. 1, p. 288.

Symptoms acute, with few exceptions.

The Symptoms which I have enumerated as common to inflammation of the iris are usually intensified in the affection now under our consideration. To this rule there are exceptions. Thus we occasionally see parenchymatous iritis, especially among syphilitic patients, run a chronic or subacute course, without inducing any very prominent symptoms; but being attended by nodular formations, it may end in extensive synechia. These, however, are exceptional instances of the disease: the symptoms generally present in parenchymatous iritis are more acute than in any other form of inflammation of the iris.

Vascular injection great.

The vessels of the iris, more particularly those covering the excrescences and surrounding their base, are engorged with blood, and the subconjunctival zone of vessels is proportionably congested; the conjunctiva is often deeply injected, and considerable chemosis may exist.

Aqueous turbid.

The aqueous is remarkably turbid, and flaky fragments of the neoplasms may often be seen floating about in it.

Post. corneal haze.

In many cases, the posterior elastic lamina of the cornea becomes hazy; its epithelial cells, undergoing fatty degeneration, become white and opaque, presenting a spotted appearance. The brilliant fibrous aspect of the iris is destroyed, and its colour, as seen through the hazy cornea and muddy aqueous, is strikingly altered. One or more nodular excrescences will be observed on the iris; they vary in size and colour, as before described.

Pupil inactive.

The pupil is insensible to the stimulus of light, and if dilatable by the aid of mydriatics, it assumes an irregular shape; the functions of the nerves, vessels, and contractile fibres of the iris being impaired by the abnormal action going on in it, or from the presence of synechia which ties it down to the lens or cornea.

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* Stellwag von Carion, American edition, p. 185.

The patient usually complains of pain in the eye and forehead from the commencement of the disease, subsequently the pain extends to the head and side of the face, and is often most excruciating, generally lessening during the day, but increasing in intensity as the night advances. Intolerance of light and increased lachrymation are also symptoms from which the patient suffers very considerably, a gush of tears pouring out of the eye the instant the eyelids are opened.

Pain severe.

The symptoms above enumerated necessarily differ in different instances, and in the several stages of the disease; but though cases of parenchymatous iritis thus vary in intensity, they terminate but too constantly in irreparable damage to the eye. This may take place in different ways: the fibro-cellular excrescences may degenerate into pus, and give rise to an abscess of the iris, the result of which is the formation of a cicatrix of greater or less extent in the connective tissue of the part. In other instances posterior synechia appears, which tends to keep up irritation and excite fresh inflammation in the iris, ultimately leading to complete closure of the pupil. Lastly, the outgrowths from the iris may reach forwards as far as the cornea, and adhesions form between the two, giving rise to anterior synechia.

Too often ends in abscess or adhesions.

Prognosis in the Various forms of Iritis.—We may now proceed to consider the data, upon which a prognosis is to be based in cases of inflammation of the iris generally. And in the first place, the type of the disease, and the progress it has already made, must be considered; for iritis presents not only different stages, but the disease is met with of very different degrees of severity. In slight, and recent cases, complete restoration may be predicted; in more serious cases, the improvement can only be partial; in severe and neglected cases, it is but too often evident that we can hold out but slender hopes of recovery.

Prognosis in iritis.

From type, and progress.

It is, however, to the presence and extent of the synechia already formed that we should principally direct our attention, in endeavouring to form a prognosis. If bands of adhesion exist between the iris and lens, they too often lead to repeated attacks of inflammation of the iris, terminating in occlusion of the pupil. And even supposing the synechia does not so

Look to synechia.

directly cause loss of sight, it may keep up irritation in the part, and thus induce congestion of the choroid, followed by degenerative changes in the vitreous, lens, or retina.

Danger of sympathetic irritation.

I am aware that many surgeons do not believe in the injurious influence which an eye, undergoing such changes as those I have now described, may exercise over the other one. It is certain, however, in my opinion, that the integrity of the healthy eye is thus endangered; and we are bound, under these circumstances, not only to give an unfavourable prognosis as regards the diseased eye, but to warn the patient of the danger he runs of losing the sight of the other eye, unless the source of irritation subsides.

In serous form, prognosis mostly favourable.

Synechia being less frequently met with in the early stages of serous than in the other forms of iritis, it follows, that in this variety we may reasonably expect to save our patient's sight, if the case is brought sufficiently early under treatment. We must bear in mind that vision is apt to remain confused and hazy for some time after an attack of this form of iritis, on account of the opaque condition of the posterior layers of the cornea, which, as I have before stated, is generally considerable. But provided the pupil dilates regularly under the influence of a weak solution of atropine, we may assure the patient that this haziness will soon pass off, more particularly if there be no contraction of the field of vision. On the other hand, serous iritis, if allowed to run its course, may induce increased intra-ocular pressure, more particularly when the diseased action extends to the choroid; it then becomes a serious affection, its danger being in proportion to the augmentation of the tension of the eyeball.

In plastic, favourable, if synechia slight.

In plastic iritis, if the adhesions are slight, or have only been recently formed, so that they can be broken through by dilating the pupil with atropine, we may form a favourable prognosis, although the patient's sight for a time may be impaired by patches of uvea which remain adherent to the capsule of the lens, and from opacities of the posterior lamina of the cornea. It may be necessary to search carefully for the deposits of uvea before they can be recognised in cases of this kind; the pupil must be dilated as much as possible, and the lateral method of examination employed; or the deposits of uvea on the capsules of the lens may be overlooked, they may be seen with facility by the aid of the ophthalmoscope. If the synechia cannot be torn down by the action of mydriatics, much may still be done to improve the condition of the patient by breaking through the bands of adhesion between the iris and lens, by means of an instrument introduced into the eye through the cornea, or by iridectomy, but our prognosis must, under these circumstances, be guarded: the patient's sight is never likely to be perfectly restored, and in too many instances will have been absolutely destroyed for all practical purposes.

In Parenchymatous, unfavourable.

In parenchymatous iritis, our prognosis, as a general rule, will be still more unfavourable, unless the disease be brought under treatment before it has made any great progress. It is true, some cases run a subacute course, giving the patient but little inconvenience, and leaving apparently no bad results behind them, but this is unusual; unless judiciously treated, the disease more commonly leads to multiple synechia and closed pupil. If, however, at any stage of the affection, we can dilate the pupil with atropine, we may with confidence expect a favourable issue, as we can then prevent the formation of synechia, and in all probability the further progress of the disease.

unless pupil dilatable.

In forming our prognosis, we should never lose sight of the fact that in all cases of iritis there is a tendency for the disease to recur, and that each successive attack is usually more severe than its predecessor, and more likely, therefore, to spread to the choroid, or leave its mark behind in the form of fresh synechia.

Sight may be clear, yet synechia complete.

There is a deceptive condition of the eye, the result of iritis, in which the patient's sight remains good, although the iris is closely bound down to the lens by synechia. This arises from the fact, that a small but clear opening remains through the pupil, and the rays of light reach the retina without hindrance; nevertheless, the sight is endangered from the closure of the communication between the chambers of the eye. Cases of this kind are but rarely met with in practice; we far more frequently see instances of closed pupil and extensive synechia, where the patient may have sufficient sight left to find his way about, but is unable to read or write with the diseased eye. If, under these

Mischief from closed pupil.

circumstances, we fail to dilate the pupil with atropine, and if the tension of the eyeball is either increased or diminished, the prognosis cannot but be unfavourable; iridectomy may improve matters, but the chances are that the choroid, and probably the retina also, will have become implicated in the disease.

Causes.

Rheumatism.

Leprosy.

Syphilis.

Injuries.

The Causes of Iritis are often veiled in considerable obscurity. Plastic iritis was formerly supposed, in the majority of instances, to occur among rheumatic patients; but the truth is, we frequently meet with this form of disease in cases where no suspicion of rheumatism exists; nevertheless, we freely admit that this form of iritis is often produced by exposure to sudden changes of temperature, to damp and cold draughts of air: we hardly ever see an instance of advanced leprosy in which plastic iritis is not present. Syphilitic patients again are subject to this form of iritis; we see it also following blows or injuries to the eye; in fact it is absolutely impossible to assign any constant cause for this disease. The same remark applies to parenchymatous iritis: we are no doubt justified in attributing it to a special cause, if the patient has had primary syphilis, and if the excrescences on the iris are particularly well defined; but we shall, in practice, meet with cases which cannot be thus accounted for.* Serous inflammation of the iris is often complicated with choroiditis; for, as I shall subsequently explain, the diseased action not unfrequently commences in the choroid and spreads to the iris. Independently of any such complications, this description of iritis is most apt to occur among persons in a debilitated state of health.

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* Mr. Hutchinson makes the following remark regarding inherited syphilitic iritis:—"Respecting the frequency of iritis in infants, there can be no difficulty in admitting that it is among the rarest of the symptoms of hereditary syphilis. I am sure, however, that it often escapes notice. The absence of the sclerotic zone, and the very small amount of local symptoms which it causes, taken with the fact that infants usually keep their eyes shut, will account for this. In proof of it I may mention that, in 1852, I showed to a friend of mine, who had then for fifteen years held a surgical appointment, which brought under his notice vast numbers of the poor, the first case of syphilitic iritis in an infant which he had seen. The disease was new to him, and he was much interested in it. Since then he has had, in exactly the same field of observation, no fewer than five cases. Yet in proof, that however carefully looked for, it is really very rare, I may mention that during four years' practice at the Metropolitan Free Hospital I have never treated a single case, although numbers of congenito-syphilitic patients present themselves, and I have scrupulously looked at the eyes in all."—*Ophthalmic Hospital Reports*, vol. i. p. 229.

Debility.

It is, however, well to bear in mind that no form of iritis is absolutely characteristic of any particular constitutional dyscrasia; consequently, it is an error to describe one form of iritis as rheumatic, another syphilitic, and so on; these and other influences, such as malaria, gout, and the like, are equally frequent causes of iritis. It is necessary, therefore, in every instance to inquire carefully into all the circumstances of the case; then, and not till then, shall we be prepared with correct principles upon which to base our treatment.

Malaria. Gout.

Treatment of Iritis and its Consequences.—After what has just been said, as to the variety of conditions which may give rise to iritis, I need hardly repeat that, before commencing the treatment of any particular case, we must endeavour, if possible, to arrive at a definite conclusion as to its origin, otherwise our efforts to cure are likely to fall wide of the mark. There is usually no difficulty in recognising the presence of a well-marked rheumatic, syphilitic, or malarious diathesis; but it is a far more troublesome matter to ascertain the nature of the case if a patient be suffering from any of those less definite ailments, induced by functional derangement of the secreting organs, which, by altering the character of the blood, interfere with the nutrition of the various tissues of the body. We must, nevertheless, attempt to do so, and also to right matters by the use of such remedial agents as we have at our command. It would, however, be quite beyond the scope of this work to enter upon any consideration of these measures, embracing, as they must, a knowledge of the influence of drugs, hygiene, and dietary on the organism, and being almost co-extensive with the whole range of practical medicine. I shall therefore confine myself to the consideration of certain drugs, and other means, which have the reputation of a peculiar efficacy in the treatment of inflammation of the iris.

***Treatment* will vary with the cause.**

Must be based on general principles.

Mercury is considered by most surgeons as an in-

Mercury:

would, of course, be unadvisable to administer so large a quantity of opium as that above recommended; the dose, in fact, must vary according to the circumstances of the case, its beneficial effects being more marked in acute forms of iritis than in chronic or subacute cases. A dose of the hydrate of chloral given at bedtime has a good effect on some patients, procuring them a night's rest; but as a general rule it is hardly likely to supersede opium.

Paracentesis of the cornea.

Paracentesis of the Cornea.—As a means of relieving the intra-ocular tension and pain, from which some patients attacked with iritis suffer, it is occasionally necessary to puncture the cornea, and allow some of the aqueous humour to escape. The point of a broad needle is to be thrust through the cornea into the anterior chamber, a small quantity of the aqueous humour is thus allowed to escape; on withdrawing the needle the wound in the cornea closes, preventing any further escape of aqueous; after this operation, a pad and bandage should be carefully applied over the eyelids.

Precautions in operating.

It is not advisable that the whole of the aqueous humour be allowed to flow out of the anterior chamber, in which case the lens and inflamed iris would run the risk of being thrust forwards against the cornea, and anterior synechia might result. When making the puncture, care must be taken that only the point of the needle is allowed to pass through the cornea; otherwise, as the aqueous escapes, the iris or even the lens might be wounded.

Relieves tension.

This proceeding is sometimes followed by marked relief, but it is a measure hardly to be resorted to unless by surgeons who have devoted much of their time to diseases of the eye. It may be necessary to puncture the cornea on two or three occasions, at intervals of about thirty-six hours, the indications for a repetition of the operation being augmentation of the tension of the eyeball and increased pain in the eye.

Leeches: relieve pain.

Leeches applied to the temple, and over the brow of an eye affected with iritis, will often exercise a marked influence on the progress of the disease; it is by no means advisable, however, to apply leeches simply because a patient is suffering from an attack of iritis, although he may have great pain in the eye and other symptoms of acute inflammation. Should the general condition of the patient's health be such as to lead us to suppose he could bear loss of blood, half a dozen leeches may be applied over the affected eye, and the part should subsequently be well fomented with hot water, so as to encourage the flow of blood from the leech-bites. If this treatment appear to exercise a beneficial action on the disease, we may repeat it on the following day, often to the great relief of the symptoms. Cases of this description are likely to be much benefited by a dose or two of blue pill and colocynth, followed by a black draught in the morning, low diet at the same time being strictly enjoined; in fact, the leeches will form a part of an antiphlogistic plan of treatment.

Seldom necessary.

Purgatives and low diet.

In the instance of a patient already weakened by pain, and perhaps mercury, leeches might be positively injurious; they should consequently be used with caution, being like all such powerful means, as useful in suitable cases as they are harmful in instances not requiring their employment.

Atropine is invaluable in the treatment of all cases of iritis, for if we can only manage to keep the pupil dilated, it is impossible for synechia to form; besides which, when the iris is well contracted on itself, forming a narrow rim round the anterior chamber, it follows that its blood-vessels can hardly remain in a state of congestion; they must, in fact, be pretty well emptied of their contents under these circumstances. The inflamed tissue is also kept at perfect rest when under the influence of mydriatics—a most important point in the treatment of all kinds of inflammation. I know, indeed, of no remedial agent which directly places an inflamed structure in a more favourable position for recovery than atropine does in cases of iritis: it enables us to secure the inflamed part rest, it lessens the calibre of its congested vessels, and it prevents the injurious adhesions which otherwise follow an attack of plastic or parenchymatous iritis, by keeping the iris well away from the lens; and lastly, by lessening the vascular supply, and diminishing the amount of the secreting surface of the iris, it controls the secretion of the aqueous humour, and in this way lessens the intra-ocular pressure.

Atropine invaluable.

Insures rest.

Lessens congestion.

Prevents adhesions,

and tension.

If a case of iritis is fortunately brought under our notice before adhesions have formed, or the structure

If early, may suffice for the cure.

of the iris has been irreparably damaged, we may with safety rely upon atropine as being the most efficient curative means at our disposal; a few drops of a solution of atropine, of the strength of one grain to two drachms of water, should be allowed to run into the eye every hour, until the pupil is fully dilated. If the pupil once become dilated under this treatment, we may confidently hope to cure our patient in the course of a short time. In the more acute forms of the disease it is often a difficult matter to bring the pupil under the influence of atropine, and it may be necessary to continue its instillation every six hours, for a period of five or six days. In some instances the atropine is unable to act, on account of the swollen and congested state of the iris; in these cases the prognosis will be less favourable, but we should endeavour to reduce the inflammatory action by mercury or iodide of potassium, and above all by the application of leeches to the temple, and then set to work again with the atropine.

Strength of solution.

It is advisable not only to dilate the pupil, but to keep it dilated for some time after all acute symptoms have passed away; in fact, till the subconjunctival zone of vessels has disappeared, and the balance of circulation in the iris has been restored.

Keep pupil dilated.

In many cases of iritis, the synechia is only partial, bands of adhesion existing between the iris and the capsule at certain spots, the remainder of the iris being sufficiently healthy to respond to the action of atropine. Under these circumstances, the pupil, in dilating, assumes all manner of shapes, expanding in one direction, and being prevented doing so in another by the adhesions. Atropine should be steadily and freely employed in cases of this description; the connecting bands are often broken through under its influence, and the existing iritis speedily subsides; and, moreover, the synechia being destroyed, subsequent attacks of iritis will probably be prevented.

Limited adhesions broken down.

While, therefore, employing the various means at our command for improving our patient's health, and, if possible, acting on the cause which has induced the iritis, we should invariably endeavour to dilate the pupil to its fullest extent with atropine, without any consideration as to the form of the disease or the progress it may have made. The prolonged use of atropine

Granular conjunctivitis from long use.

Poisonous effects.

may induce an attack of acute granular conjunctivitis, and if we observe any symptoms indicating the commencement of an attack of this kind, the instillation of atropine must be at once stopped, but we may apply the extract of belladonna mixed with atropine over the patient's eyelids and temple. I have seen alarming symptoms of poisoning by atropine follow the application of a strong solution of this drug to the eye, but they were cases in which only a small quantity of atropine had been used, being instances of a peculiar and uncommon idiosyncrasy on the part of the patient to the poisonous influences of atropine. Exceptional cases of this kind should not for an instant prevent our using atropine as I have above advised in all cases of iritis.

Gelatine tablets.

Atropine may be conveniently applied in some instances mixed with gelatine, so as to form small tablets; or upon pieces of paper saturated with a solution of it, and then dried. A tablet or a piece of paper thus prepared is placed on the conjunctiva of the everted eyelid; the eye may then be closed, and the lachrymal secretion dissolving the atropine, it becomes absorbed, as it would be if dropped into the eye as an aqueous solution.*

Belladonna

Extract of belladonna is a less potent remedy than atropine, and is not to be relied on for dilating the pupil in iritis. Equal parts of extract of belladonna, Indian hemp and glycerine, to which atropine has been added, form a useful mixture, which may be smeared over the affected eye to relieve ciliary neurosis.

Fomentations.

Hot compresses

Fomentations, Shades, etc.—Poppy-head fomentations are often soothing to the patient, and whenever this is the case, they may be used with advantage five or six times a day; if they do not relieve the pain, it is advisable to discontinue them. M. Wecker employs hot water compresses of as high a temperature as the patient can bear, to be changed every ten minutes, in cases of parenchymatous iritis. The hot compresses must be continued day and night; there can be no question as to compresses of this kind being most useful in many cases of parenchymatous iritis.

Pad and bandage.

In all instances of iritis the affected eye should be shaded from the light; I find it very convenient in many cases to cover the eye with a light pad and bandage, our object being not to apply pressure over the eye, but simply to keep the eyelids closed and the parts at rest; if at the same time the sound eye be protected by a shade or green spectacles, the patient is often able to leave his dark room and enjoy the society of his friends, or even attend in part to his business. These are apparently trivial matters, but are nevertheless well worthy of consideration, as they tend to relieve the irksomeness of solitary confinement, which is too often the patient's doom if he remains in a dark room; by keeping up his spirits, we do much towards preventing his falling into a low state of health, which would certainly react on the local inflammation and probably impede his recovery.

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* *Brit. and For. Med.-Chir. Rev.*, Jan 1st, 1864.

Shades.

Counter-irritation, in later stages.

Counter-irritation, in the form of blisters to the temple, is comparatively useless in the active stages of iritis, but subsequently it is beneficial, especially when the patient suffers from dimness of vision, depending on haziness of the posterior layer of the cornea.

Scarification in chemosis.

The conjunctivitis, which is always present in iritis to a greater or less extent, may, as a general rule, be allowed to run its course; if it should be excessive, it may be well to scarify the swollen tissue, and thus relieve the chemosis. A strong solution of nitrate of silver should be painted over the skin of the lids, if they are puffy and swollen, but it is not advisable to drop astringent lotions into the patient's eyes in these cases.

Iridectomy;

only after other means have failed.

Supposing the case of iritis is one which has resisted all the means of treatment described in the foregoing sections, and rather grows worse, that the pupil will not dilate by atropine, and that the patient's sight is growing more and more dim, the intra-ocular tension being increased—we are no doubt justified as a last resource in performing an iridectomy. This operation in fact holds out the best and probably only hope for the patient; nevertheless, iridectomy in cases of iritis is, be it remembered, our last hope: we have no right to fall back upon it until every other means of cure has been attempted, for according to my experience, it is by no means so successful in cases where active changes are going on in the iris, especially if due to syphilis, as it is in some other forms of disease. Subsequently, when the signs of irritation or inflammation have passed away, and the patient applies to us suffering from synechia, we may, as I shall presently notice, without hesitation resort to the operation of iridectomy. The only question is, may we operate during the attack of iritis? I think we are only justified in doing so under the circumstances above detailed.

Treatment of fever.

The Treatment of Constitutional Symptoms, such as intermittent fever, will consist partly in the employment of hot baths and sudorifics, but the administration of opium tends towards allaying fever of this kind, as well as relieving the troublesome vomiting occasionally met with among patients suffering from iritis. The state of the bowels must be attended to, but to administer purgatives indiscriminately, because an individual is suffering from inflammation of the iris, is a most unphilosophical proceeding, and may complicate matters by disordering the digestive organs, which have frequently nothing to do with the disease of the eye.

Alteratives.

Various drugs.

In numerous cases of iritis, especially in a malarious country like Bengal, we shall have to resort freely to the use of quinine, arsenic, aconite, strychnine, and iron, for the cure of the disease; but, as I have before observed (p. 311), it would be impossible for me in a work of this kind to attempt to describe the peculiar circumstances under which either one or other of these drugs are called for. I can only as it were sketch out the plan of the building upon which our work is to be raised.

Food and stimulants with discretion.

With regard to the use or withdrawal of stimulants and food, these are doubtless powerful agents in the treatment of disease. In a case of iritis occurring in a plethoric individual, purgatives, starvation, and in fact depleting treatment are called for; but a vast number of cases of iritis are of an asthenic type, and require a moderate amount of stimulants, good wholesome food, and fresh air; in some cases we shall have to administer bark and ammonia, together with wine and beef-tea. It is impossible to lay down absolute rules on these matters which shall be applicable to all cases; nothing but observation and experience can guide us to a right conclusion; and as one man's powers differ from those of another in appreciating these circumstances, so will the one differ from the other in his success in practice.

Synechia.

Management of Synechia.—Supposing the patient's sight to be impaired by synechia, or bands of adhesion which have formed in the pupil, we must, in the first instance, endeavour to dilate the pupil by a persevering use of atropine, as I have already described; but in case the adhesions cannot thus be broken down, and provided the acute inflammatory symptoms have passed away, it will be necessary to resort to one of two operations, Corelysis or Iridectomy, our choice depending on the nature of the case.

First use atropine.

Corelysis in partial synechia.

To break down adhesions.

In instances where the pupil is only partially closed, or when the synechia binds the iris down to the lens at one or more points, a portion of its margin remaining free, if atropine, after a persistent trial, fails to dilate the pupil and break down the bands of adhesion, we must proceed to perform the operation of corelysis, as recommended by Mr. Streatfeild.* For adhesions involving more than the margin of the pupil, and when the iris is completely tied down to the lens, we must resort to iridectomy.

Preparatory steps.

Corelysis.—The steps to be taken in performing the operation of corelysis are as follows:—A solution of atropine must first be dropped into the patient's eye three or four times a day, for a week prior to the operation; we shall thus be able to discover those parts of the margin of the pupil which are still free from adhesions, by the pupil dilating at those points; and as our object is to insert a small spatula through an opening of this kind, between the lens and iris, and then carefully to break down the synechia with the instrument, so as to free the iris from the capsule, this careful study of the condition of the parts, before we attempt to operate, is very necessary.

Details of the operation.

This done, the patient is placed in the recumbent position, and chloroform having been administered, a stop-speculum is adjusted, and the surgeon, standing behind his patient, secures with a pair of fixing forceps a fold of conjunctiva close to the margin of the cornea, so as to steady the eyeball. A sufficiently large puncture is then made in the cornea, as nearly as possible opposite to the principal adhesion; a Streatfeild hooked spatula is inserted through the wound into the anterior chamber, and the blunt extremity of the instrument is passed under the margin of the pupil, and between the iris and lens (its point being carefully directed away from the latter) and far enough beneath the iris, to enable us, by a slight lateral and traction movement, to lift the iris away from the lens and break through the synechia. The hook near the extremity of the instrument is very useful, enabling us to tear through any tough bands of adhesion, which might otherwise become elongated when force is applied, and so elude our best efforts to reinstate the pupil.

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* *Ophthalmic Hospital Reports*, vol. ii. p. 309.

Caution as to lens.

It is necessary to be careful not to wound the capsule of the lens during this operation; but if the patient is fully under the influence of chloroform, and if too much is not attempted at a time, it usually escapes uninjured. Those parts of the synechia only, which are opposite the point of puncture in the cornea, should be broken through during one operation: for instance, if the adhesions we propose dividing are situated on the inner side of the pupil, but if there are also others above and below the pupil, we should make our puncture in the outer part of the cornea, and passing the spatula through it, insert the point of the instrument beneath the inner margin of the pupil, breaking down the adhesions in this situation, and leaving those above and below for a future operation. For the division of these the punctures must be made in the lower and upper part of the cornea respectively.

Successive operations required.

Further directions.

It is a point of some importance in operating, to take care that the aqueous humour be prevented from escaping till after the synechia is broken through. This may generally be managed by having a spatula just large enough to fill the puncture made in the cornea. It is impossible to lay down any precise rules as to the distance from the margin of the cornea at which the opening should be made. Our aim should be to select a spot which will most readily admit of our passing the spatula through it, in such a direction as to avoid the lens, and enable us to break through the adhesions at the greatest advantage.

Preserve aqueous.

The operation of corelysis is equally applicable to cases where the pupil is partially closed by organized plastic formations; the false membrane may be broken through as above described. The same remark applies to instances of anterior synechia.

Atropine afterwards.

The after-treatment is very simple. Atropine must be dropped into the eye three times a day, so as to dilate the pupil as far as possible, and the eye is to be kept closed with a pad and bandage for ten or twelve days; we may then proceed to break through any remaining adhesions, if the irritation caused by the former operation has subsided.

Iridectomy in closed pupil.

Iridectomy.—As I before remarked, in cases where the pupil is entirely closed by false membranes, or its margin wholly bound down to the lens by synechia, should we even desire to do so, it is impossible to perform the operation of corelysis, and it becomes necessary to resort to iridectomy. If this proceeding is neglected in cases of this description the communication between the chambers of the eye being closed, an accumulation of fluid takes place in the posterior and vitreous chambers which is certain in time to produce destructive changes in the retina. In these cases of closed pupil, the outer part of the iris often bulges forwards towards the cornea, from the pressure of the aqueous fluid behind it; but its pupillary border, being bound down to the lens, cannot be thrust forward in this way, and appears, as it were, in a pit, the iris being funnel-shaped.

Prevents posterior tension.

Numerous proceedings have been advocated for the relief of this state of things, among which operations for the formation of an artificial pupil hold a prominent place; but it may now be safely affirmed that an iridectomy is the most satisfactory practice. Iridectomy embraces all the advantages of an artificial pupil, and, in addition, has many of its own to offer, not the least of which is, that it tends greatly to lessen the chances of recurrent iritis. It may therefore be stated generally, that in instances of synechia, or closed pupil, which cannot be broken through by the aid of mydriatics or the operation of corelysis, we must resort to iridectomy, excising about one-fourth of the upper section of the iris.

Restores sight.

Prevents recurrent iritis.

Should not be delayed.

In this class of cases the operation should be performed as soon as the active symptoms of iritis have passed away, seldom before: it is not necessary, however, to wait till all pain and irritation in the eye have subsided; for these symptoms are perhaps kept up by the synechia, and, if we wait till the irritation has entirely passed away, it may be that the integrity of the deeper tissues of the eye will have been destroyed in the meantime.

Indications for and against.

Amount of sight.

The amount of sight a patient may possess is hardly a safe guide as to the necessity for iridectomy; the central portion of the pupil may be clear, and yet no communication may exist between the chambers of the eye; and under these circumstances, although the patient may see tolerably well, we must not hesitate to perform iridectomy. On the other hand, if the patient has no perception of light, it is almost useless operating with an iddea of improving the sight; for it is more than probable that detachment, or other destructive changes in the retina, which iridectomy cannot possibly influence, have taken place.

Bulging iris;

Capsular opacity.

In cases where the iris bulges prominently forwards towards the cornea, indicating the collection of a considerable quantity of fluid in the posterior chamber, iridectomy is less likely to be successful than if the iris is in its normal position. These chances are still further reduced if we can make out a central opacity in the capsule of the lens, a condition often indicative of detachment of the retina.*

There may be some little difficulty in removing a portion of the iris, in cases where it is swollen from the pressure of the products of inflammation, or has undergone atrophy. Under these circumstances, Von Graefe remarks:—

Graefe's forceps.

"I employ straight, pupillary forceps, with sharp teeth, which, instead of following the ordinary direction, I apply to the iris somewhat perpendicularly; according to my experience, such an instrument is of very great service under these circumstances."†

Traumatic Iritis.

TRAUMATIC IRITIS.—The general principles upon which we should conduct the treatment of a case of traumatic iritis, differ in no respect from those already laid down for our guidance in other forms of inflammation of the iris; but we frequently meet with complications in these cases, arising from the lens having been injured, together with the iris. Under these circumstances, the capsule is often perforated, and the lens substance swells, becomes opaque, and by pressing upon the iris, keeps up violent irritation and inflammation of the part.

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* Professor A. von Graefe "On Iridectomy," p. 266. (New Sydenham Society.)

† Idem, p. 284.

Lens often wounded.

Excise the iris and remove the lens.

Whenever a case of this kind presents itself to our notice, it is well to remove the lens at once. The patient should be placed under the influence of chloroform, and a Weiss's stop-speculum having been adjusted, the surgeon should make an opening through the upper portion of the sclerotic as if for iridectomy; about a fourth of the iris should be excised, and the lens must then and there be removed, if necessary by aid of a scoop. A few drops of a strong solution of atropine are subsequently to be dropped into the eye, and the case treated as one of ordinary linear extraction.

Delay dangerous.

The success of this operation, in cases such as I have above described, depends upon the promptness with which it is undertaken. If the surgeon attempts palliatives, such as leeches and the like remedies, in the hope of reducing the inflammation, the chances are that his opportunity will slip away, and general inflammation, and perhaps abscess of the globe will supervene; whereas, if iridectomy is at once performed, and the lens removed, the patient will be saved much suffering, and with the aid of an artificial lens in the shape of spectacles, may regain a very fair amount of vision.

A foreign body in the iris, to be removed.

Occasionally a chip of steel, or some such foreign body, gets lodged in the iris, causing violent inflammation. Supposing the lens has not been wounded, we may succeed in extracting the foreign body with a pair of cannula forceps; or, I do not hesitate to make a free opening in the cornea, and introduce a pair of iridectomy or other small forceps, to secure and remove the offending substance. Should the lens be also involved, a traumatic cataract being present, it is advisable to perform an iridectomy, including the foreign body in the portion of the iris excised, and then extract the opaque lens as above described.

I have already stated that degenerative changes in one eyeball may, by sympathetic irritation, affect the other eye, causing an insidious form of iritis, or irido-choroiditis, which generally advances steadily, and ends in total blindness, unless we can remove the diseased eyeball, which is the primary source of irritation.

In sympathetic iritis, remove bad eye.

WOUNDS AND INJURIES OF THE IRIS.

INCISED WOUNDS.

INCISED WOUNDS.—I have given an account of the symptoms and treatment of prolapse of the iris following perforation of the cornea (page 268), it is consequently unnecessary for me to return to the subject.

Rarely simple.

A simple incised wound of the iris is a rare accident, for in the majority of instances the lens is involved in the injury, and a traumatic cataract results. Incised wounds of the iris are always attended with more or less hæmorrhage into the anterior chamber, and temporary impairment of vision. Inflammation seldom follows clean incisions of the iris, as for instance those made in the formation of an artificial pupil, but the edges of the wound gape open, leaving a space through which the rays of light reach the retina. Occasionally the lips of an incised wound unite, a blood clot forming between them, its fibrine becoming organized, drawing the edges of the wound together; but in instances of this kind the contractile power of the iris has commonly been impaired by previous inflammation, which prevents the wound from gaping open as it does in the healthy tissue.

Not followed by inflammation. Apt to gape.

After an incised wound, the eye must be kept at rest until the blood in the anterior chamber has become absorbed. We can hardly venture on a prognosis till this has occurred.

FOREIGN BODY IN IRIS.

FOREIGN BODIES sometimes become lodged in the iris without wounding the lens; they may be best seen on examining the eye by the oblique method of illumination. Having discovered the situation of the offending particle, the cornea should be punctured, and a pair of cannula forceps passed into the anterior chamber; the foreign body being seized, it may usually be withdrawn from the eye without difficulty. The pupil should subsequently be kept fully dilated, and the eye at perfect rest, till all signs of irritation have subsided.

Should be removed,

It will generally be necessary to administer chloroform, in order that we may command the eye during

under chloroform,

without delay.

the operation, and we should never delay the removal of the foreign body for one hour longer than is necessary. If the eye is already inflamed, this will be an additional reason for immediate interference, rather than an indication for delaying the operation. Should there be any difficulty in seizing the foreign body, it is advisable to make a larger opening in the cornea, and to excise a portion of the iris, removing it from the eye together with the foreign body.*

Rarely becomes encysted.

Instances have been recorded, and I have myself met with them, in which particles of steel and similar substances have become encysted in the iris, and yet given rise to no irritation; but cases of this description are so rare, and destructive inflammation of the globe of the eye so constant a result of the presence of a foreign body in the iris, that we are not justified in trusting to nature in such cases.

Dilate the pupil in all cases.

In wounds of the iris, whether incised, or resulting from the presence of a foreign body in the eye, it is advisable to dilate the pupil with atropine, before venturing on a prognosis, or any particular line of treatment; because the lens may have been wounded, and the point of injury, which is perhaps covered by the iris, may not be apparent until the pupil is fully dilated. A complication of this kind would, of course, materially affect the prognosis, a traumatic cataract in all probability resulting from the injury to the lens.

DETACHMENT OF IRIS

from a blow.

Extent of injury concealed by blood.

DETACHMENT OF THE IRIS from its ciliary border may be complete, that is, the whole of the iris may be detached; or a mere slit may exist in its ciliary border. An accident of this kind usually occurs from an injury, as for instance from a blow with the fist upon the eye. In these cases the nature of the accident may not be detected in the first instance on account of the effusion of blood which takes place into the anterior chamber. It will be necessary, therefore, to be guarded in our prognosis, as it is impossible to determine the extent or nature of the injury, or if it be complicated with detachment of the retina, until the effused blood has become absorbed.

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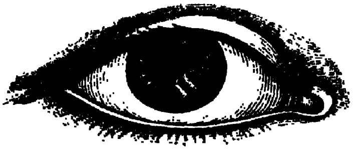
* See cases in point, by F. Horner: *Ophthalmic Review*, vol. i. p. 166.

False pupil formed.

If a portion of the iris has been detached from its ciliary border, as soon as the aqueous becomes clear, we shall notice a false pupil, varying in size according to the extent of the detachment of the iris (*vide* Fig. 28). The part of the pupil corresponding to the detached border of the iris is uninfluenced by the stimulus of light, its nerves and contractile tissue having been torn through at the point of separation of the iris from its ciliary border. In instances where the line of separation is narrow, it often requires a very careful examination of the parts to detect the lesion, and to account for the otherwise inexplicable irregularity and inaction of a portion of the pupil.

FIG. 28.



Sight impaired.

A patient's sight is usually somewhat impaired by an accident of this kind, the irregularity of the pupil interfering with perfect vision; and if the rent in its ciliary border is a large one, a number of extraneous rays of light enter by the artificial pupil, and falling on the retina, produce considerable confusion in the visual image. In a remarkable instance the whole of the iris was removed by Von Graefe; and what is most curious is the fact recorded by Mr. Soelberg Wells, that the patient's vision was as perfect without his iris as with it. Mr. Wells remarks of this case*—"The field of vision of the right eye, in which the iris had been extracted, is normal; the sight most excellent, so that the patient can count fingers at the distance of 120—140 feet, and can read the smallest print. He possesses great power over the dispersed rays, and does not find himself in the least dazzled by the light. And, lastly, to crown all, the accommodative power of this eye, with its *irideremia totalis*, is almost perfect ($\frac{1}{8}$—$\frac{1}{7}$)."

Case of total loss of iris.

Vision unimpaired.

Treatment nil.

We can do little in the way of treatment, in cases of detachment of the iris, beyond keeping the eye at rest, for the accident is irremediable, so far as the reparation of the injury is concerned.

Ophthalmic Hospital Reports, vol. ii. p. 199.

LACERATION OF THE PUPIL.

LACERATION OF THE PUPIL.—A few cases of laceration of the pupillary margin of the iris have been recorded, following blows, and unaccompanied by either a wound or external injury to the globe of the eye.* It is difficult to conceive how an accident of this kind can take place from concussion, nevertheless a rent of the pupillary border, and in other cases rupture of the fibres of the iris, have been known to follow it. As the opening in the iris is nearer the axis of vision than in detachment of its ciliary border, the defect of sight is greater, because the rays of light fall on the retina nearer the macula lutea.

Visual disorder greater.

TUMOURS OF THE IRIS.

CYSTS OF IRIS

often follow a clot of blood.

CYSTIC TUMOURS OF THE IRIS are rare, and when met with, as a general rule, follow an injury to the eye, and the formation of a clot of blood in the substance of the iris; but independently of accidents cystic tumours do occasionally grow from the iris. They usually appear as a small transparent vesicle springing from a broadish base attached to the anterior surface of the iris. Mr. Hulke remarks—"An examination of all the cases which I have been able to collect shows: I. That cysts, in relation with the iris projecting into the anterior chamber, originate in two situations, 1, in the iris; and 2, in connexion with the ciliary processes. The first lie between the uveal and the muscular stratum of the iris, and are distinguished by the presence of muscular fibres upon their anterior wall; the second lie behind the iris, and bear the uveal as well as muscular strata on their front. II. It also shows that these cysts are of more than one kind; that there are, 1, delicate membranous cysts, with an epithelial lining and clear limpid contents; 2, thick-walled cysts, with opaque thicker contents (whether these are genetically distinct from 1 we are not yet in a position to determine, but it seems probable that they are so); 3, solid cystic collections of epithelium, wens or dermoid cysts; 4, cysts formed by

Varieties.

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* "Injuries of the Eye, Orbit, and Eyelids," by G. Lawson, p. 123. See also M. Wecker's "Maladies des Yeux," p. 399. Case in point, *Ophthalmic Review*, vol. ii. p. 213.

deliquescence in myxomata. III. As regards treatment, puncture, simple or combined with laceration, is so generally unsuccessful, that excision is always preferable. It is evident that the chances of success will be proportionate to the completeness of the excision, and the practicability of this will vary with the size of the cyst and the extent of its connexions, and with its position in or behind the iris."* It is clearly advisable, therefore, to excise the cyst together with the segment of the iris from which it springs, as speedily as possible, otherwise the abnormal growth may excite dangerous irido-choroiditis, or sympathetic disease in the other eye.

Should be excised.

CONDYLOMATA.

CONDYLOMATA may often be seen springing from the iris in cases of parenchymatous inflammation, and I described their appearance when speaking of that affection. Should the condyloma increase to any considerable size, it may, by coming in contact with the cornea, excite keratitis, which no treatment will relieve until the cause of the irritation has been removed.

Generally syphilitic;

The syphilitic history of the case would lead us to a correct diagnosis of the disease; and its treament is comprised in that already recommended in parenchymatous iritis. There is only one condition of the parts, that I am aware of, which could be mistaken for the disease in question, and that is the presence of neoplastic growths, such as are sometimes observed on the iris in those who suffer from leprosy; but the appearance of the patient, under these circumstances, would at once correct an erroneous impression as to the nature of the disease. It is possible, of course, that a leprous patient may contract syphilis, and therefore suffer from condylomata of the iris, but such cases are rarely met with.

Sometimes leprous.

CANCER OF IRIS.

MEDULLARY CANCER of the iris is occasionally seen. A case of this kind, under Mr. Dixon's care, presented the following characters:—The patient appears to have been a healthy man, twenty-five years of age. It was quite uncertain how long the tumour had been in existence, but when first seen it almost filled the anterior chamber; it was a greyish, jelly-like mass, with opaque points scattered through it, and was

Case.

Ophthalmic Hospital Reports, vol. vi. p. 16.

abundantly supplied with minute bloodvessels; the cornea was transparent, and until the mass covered the pupil the man could see perfectly.* Mr. Dixon removed the eyeball, and the patient made a rapid recovery; and up to the time of the publication of the report no return of the disease had occurred.

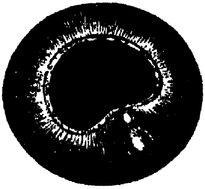
Successful removal.

Another case of a very similar nature, is detailed in the same number of the Ophthalmic Reports, by Mr. Cowell. But cancer commencing in the iris is a comparatively rare affection; and malignant disease of the internal tunics of the eye usually finds its nidus in the choroid, and gradually invades the other structures contained within the eyeball.

Cysticercus of Iris.

CYSTICERCI OF THE IRIS are occasionally met with; Fig. 29 is a copy of a drawing from one made by Mr. Teale, jun., showing the position of a cysticercus attached to the iris, which he removed, together with a portion of the iris, by an iridectomy. The eye, prior to the operation, presented the following appearances:—On the surface of the lower part of the iris was seen an opaque body, constricted in the middle, and rather larger than a hemp-seed, which was evidently causing some distress to the eye. The conjunctiva was slightly injected; the cornea was bright, but dotted on its posterior surface with minute spots, as in corneo-iritis; the iris was active, except at the situation of the white body, near which it was adherent to the capsule of the lens; tension normal. Reading No. 16, Jaeger.†

FIG. 29.



Appearance.

In instances of this kind the plan of treatment adopted by Mr. Teale possesses considerable advantages over any other, the cysticercus being removed from the eye, together with the portion of the iris to which it was attached, by an iridectomy.

Removal by iridectomy.

LEPROUS AFFECTIONS OF THE IRIS are extremely common among persons suffering from leprosy—in fact, in cases of this disease of long standing, it is rare to find the iris and cornea healthy. I have observed that as a general rule the cornea is affected before the iris in these cases, and that plastic iritis is more common than the parenchymatous form of disease. Leprous tubers form on the iris as they do on the cornea, and especially on the conjunctiva, *vide* page 293.

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* *Ophthalmic Hospital Reports*, vol. v. p. 230.

† *Idem*, vol. v. p. 320.

FUNCTIONAL DISEASES OF THE IRIS.

MYDRI-ASIS.

Simple dilatation of pupil.

MYDRIASIS is an abnormal dilatation of the pupil, occurring independently of disease of the deeper structures of the eye; so that, although the pupil does not contract on exposure to light, and the patient suffers from impairment of vision, in consequence of the excess of light admitted into the eye, still this defect is remedied by placing a diaphragm, with a small hole drilled through it, in front of the eye. The outer rays of the cone of light impinging on the retina being cut off, the defective vision is in great part corrected; and the patient, while looking through the hole in the diaphragm, sees well. This contrivance will not, of course, overcome defects due to loss of accommodation, depending on causes similar to those which induce the mydriasis. The same result may be attained by causing the pupil to contract by the application of Calabar bean to the eye. The above definition of *mydriasis*, therefore, excludes all cases of dilatation of the pupil depending on deep-seated disease of the eye.

Causes: paralysis of third nerve.

Irritation of sympathetic.

Mydriasis may be confined to one eye, or both eyes may be affected. The cause of the dilatation of the pupil may be the suspension of the functions of the third nerve, the circular fibres of the iris being thus paralysed, for when this nerve is divided the pupil remains dilated. The same effect may be induced by irritation of the cervical branches of the sympathetic, which are distributed to the dilatator pupillæ: this muscle being thrown into action, the pupil dilates.*

Treatment.

The Treatment must evidently depend on the nature of the disease. In some few instances it appears to arise from reflex action, excited by the presence of a foreign body on the cornea or conjunctiva; or it may be that some more distant branch of the sentient nerve is in the first instance affected, the irritation being conveyed by reflex action through the oculo-motor nerve, and thereby destroying the contractile power of the circular fibres of the iris. In these cases our first care should obviously be to remove, if possible, the cause of the irritation.

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* J. Bell on the Pathology of Certain Forms of Dilated Pupil. *Edin. Med. Journal*, No. X., p. 917.

Remove the cause of irritation.

Faradization.

If the mydriasis appears to depend on defective action of the third nerve, Faradization may be useful; the action of the galvanic current, however, should never be continued for more than a few seconds at a time,* and if the pupil does not contract speedily under its influence, we can expect but little benefit from continuing this treatment. Should the patient have suffered from syphilis, the case must be treated upon the principles generally applicable under such circumstances.

Anthelmintics and purgatives.

If the dilatation of the pupil results from irritation going on in the intestinal canal, whether excited by worms, or any other cause, and propagated through the sympathetic to the radiating fibres of the iris, we must endeavour to remove the source of irritation by anthelmintics in one case, and by a blue pill and black draught in another. From my own experience, I am inclined to believe that some such source of irritation is the most frequent cause of mydriasis; and these remote remedies may do more to overcome the dilatation of the pupil than anything else. The affection may be relieved by the instillation of a solution of Calabar bean, but can hardly be cured unless by appropriate treatment directed towards the restoration of the functions of the stomach, liver, or any other organ which may appear to be at fault.

Tonics in anæmia.

We might class among these cases instances of excessive anæmia, following disease of the spleen, in which dilatation of the pupil is accompanied by accommodatory asthenopia. The cause of the impairment of vision in these instances is obvious enough, and the old prescription of "plenty of water, air, and iron," or "washing, airing, and ironing" your patient, is the only rational plan of treatment.

Myosis.

Myosis is precisely the opposite condition to mydriasis; the pupil being abnormally contracted, and failing to dilate as it should do when the patient is

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* *Vide* page 100.

Pupil contracted,

placed in a dark room, or after sunset. The pupil will, however, expand under the influence of mydriatics; and it may then be noticed that it is perfectly regular, and hence its inability to dilate is clearly not dependent on synechia.

From excitation of the third nerve.

The contraction of the pupil under ordinary circumstances is a reflex action, excited by the stimulus of light falling on the retina, and being propagated to the oculo-motor nerve, so that the circular fibres of the iris contract and close the pupil (see p. 8). If only a small quantity of light enters the eye, as is the case after sunset, its action on the retina is slight; and, consequently, the excitation of the third nerve is proportionably less than in daylight, the pupil remaining semi-dilated. Division of the sympathetic in the neck is likewise followed by contraction of the pupil, the *dilatator pupillæ* being paralysed: lesions of the spinal cord affecting the sympathetic may thus produce myosis; so that, in instances of myosis, we must consider all the circumstances of the case by the light of our knowledge of the physiology and pathology of the third and sympathetic nerves. This condition is occasionally caused by long-continued work upon minute objects, as for instance in watchmakers the sphincter muscle of the iris acquiring a preponderating power over the dilatator.

Or paralysis of sympathetic.

Mistaken for night blindness.

Cases of myosis are sometimes mistaken for hemeralopia (night blindness), in that the patient complains principally of impairment of vision coming on after sunset, which evidently depends on an insufficiency of light reaching the retina, through the contracted pupil, to produce distinct vision. The patient has no pain in the eye, and his sight is good during the day. The case very much resembles one of hemeralopia, with this difference, however: that in hemeralopia the pupil acts freely, the disease essentially consisting in a temporary loss of power in the retina, arising from over-stimulation, or from anæmia of its nervous elements; the latter being by far the most common cause of night blindness.

Dyspepsia a cause of myosis.

We know at present so little about the functions of the sympathetic, that it is impossible to understand why, in some cases of habitual constipation, or of dyspepsia, myosis occurs. We suppose that it arises from some disturbance of the sympathetic, propagated to the branches supplying the iris—a very vague explanation, it is true, but the best we can give of the matter. In cases of this kind, our wisest plan of treatment is to correct and improve the state of the digestive organs as far as we can.

Affection of the brain.

Irritation of the oculo-motor nerve, arising from meningitis, or a clot of blood, or other affection of the brain substance from which the nerve originates, may induce contraction of the pupil; but under these circumstances, the myosis is a very unimportant matter in comparison with the primary disease.

Artificial mydriasis, and myosis, may be induced respectively, by the action of atropine and Calabar bean, as well as by some other drugs.

TREMULOUS IRIS

from loss of lens.

TREMULOUS IRIS (iridodonesis) is very seldom seen unless the lens has been removed. As the iris rests on the crystalline, we can readily understand that when the lens is taken away, having lost its support, it hangs like a loose curtain in the anterior chamber, and consequently has a tremulous movement imparted to it when the eye is turned from one side to the other. The same result may occur from an excess of aqueous in the posterior chamber, forcing the lens backwards and the iris forwards (hydro-ophthalmia) —a condition but rarely met with. If the vitreous is in a fluid condition, the lens may sink deeply into it, receding from the iris, and iridodonesis result. Under these circumstances, the ophthalmoscope will reveal the nature of the disease, and the cause of the tremulous movement of the iris.

Excess of aqueous.

Fluid vitreous.

HIPPUS.

Irregular movement of iris.

HIPPUS.—In this affection of the iris, the pupil dilates and contracts rapidly, involuntarily, and independently of the stimulus of light. It is usually met with in cases of retinal disorder, and still more often in affections involving the membranes of the brain. It has been noticed as occurring in instances of

NYSTAGMUS.

NYSTAGMUS.—This latter condition of the eye is described by Dr. Mackenzie as being an involuntary motion of the eyeball from side to side, due to clonic spasm of the recti, and symptomatic of various nervous diseases: as hysteria, epilepsy, chorea, and so on.

ARTIFICIAL PUPIL.

ARTIFICIAL PUPIL.

THE OPERATIONS usually employed for the formation of an artificial pupil are three in number. 1st. Excision of a portion of the iris; 2nd. The operation known as iridesis, or displacement of the pupil; 3rd. Iridectomy.

Various operations.

Before describing the method of performing these operations, I would observe that the chief danger we have to avoid in practising them is, not to wound the lens, and thereby cause a traumatic cataract. Ordinary caution, especially if our patient is under the influence of chloroform, will enable us to steer clear of this danger; and it is almost impossible to lay down any rules which would be of assistance in the matter. A gentle hand and steady eye, with a thorough knowledge of the anatomy of the parts, are the principal requirements in these as in other operations on the eye.

Caution as to the lens.

1. EXCISION OF THE IRIS.—Chloroform having been administered, the patient being laid on his back upon a couch in front of a good light, and a stop-speculum adjusted, the surgeon stands in the position most convenient to effect the work he has to perform, and secures the eyeball by seizing a fold of the conjunctiva, near the margin of the cornea, with a pair of toothed forceps. He then passes a broad needle through the margin of the cornea, at a spot nearest to the point at which he proposes excising the iris. A Tyrrell's blunt hook is to be inserted sideways through the opening in the cornea, and passed onwards until its hooked extremity reaches the margin of the pupil, when it is to be turned downwards, so as to hook over the pupillary margin of the iris. The instrument is then to be carefully withdrawn from the eye, being again partly rotated, and dragging with it a small fold of the iris. Immediately this fold is drawn out beyond the wound in the cornea, an assistant should snip it off, close to the edges of the wound, with a pair of curved scissors; the speculum is then to be removed, and the eye kept closed with a pad and bandage for a few days.

1. Excision of Iris.

Operation with Tyrrell's hook.

Withdraw and excise a fold of iris.

If an extensive and deep opacity of the cornea exists immediately in the axis of vision, preventing our seeing the edge of the pupil, although it may have been dilated with atropine, it is evident that we cannot perform the operation above described. It would be a dangerous proceeding to grope about with the blunt hook in the anterior chamber, in the hope of seizing the pupillary margin of the iris, which we cannot see through the opaque cornea. Under these

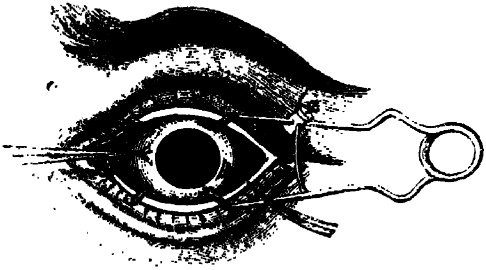
Modification in corneal opacity.

circumstances a modification of Tyrrell's operation is rendered necessary.

Operation with forceps.

In place of passing a hook into the anterior chamber, it will be requisite to make the opening in the cornea sufficiently large to allow of a pair of cannula or iridectomy forceps being introduced into the eye. A fold of the iris, as near as possible to its pupillary margin, is to be seized, and having been withdrawn through the wound, is to be snipped off close to the cornea by an assistant (Fig. 30). Care must be taken that the iris is, if practicable, excised from its pupillary margin outwards.

Fig. 30.



2. Iridesis. Operation.

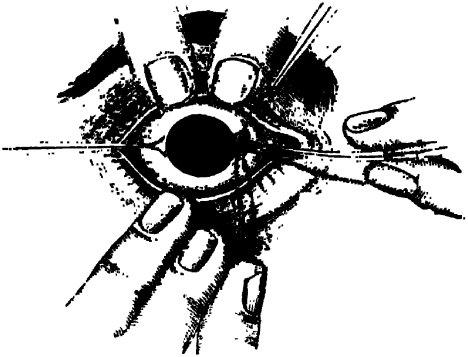
2. Iridodesis, or Iridesis.—Another operation employed for the formation of an artificial pupil, and named "Iridesis," is performed as follows. The position of patient and surgeon is precisely the same as in the operation above described: the eyelids are to be separated with a spring speculum, and the globe of the eye fixed by seizing a fold of the conjunctiva near the inner margin of the cornea. A narrow-bladed knife is then to be passed through the sclerotic, close to the margin of the cornea, the blade of the instrument penetrating the anterior chamber immediately in front of the iris; a pair of cannula forceps is to be introduced into the eye through the wound, and a fold of the iris is to be seized about midway between the ciliary and pupillary borders; the forceps are then to be withdrawn, together with the fold of iris, through the

A fold of iris withdrawn.

wound, so as to drag the pupil towards the sclerotic. In place of excising the extruded portion of the iris,

A ligature applied.

FIG. 31.



as in the last operation, a fine silk ligature is to be tied round it close to the lips of the wound. The small knob of strangulated iris thus formed will be sufficiently large to prevent its slipping back into the anterior chamber (Fig. 31). Subsequently, the edges of the wound unite, and effectually entangle the iris in the cicatrix, thus keeping the pupil permanently displaced outwards.*

Preparation of the ligature.

As there is some little trouble in applying the ligature to the fold of the iris, after it is drawn through the wound in the sclerotic, it is well to be prepared beforehand for this difficulty. After the opening in the sclerotic has been completed, Mr. Critchett recommends that a loop of fine silk be passed over the end of the cannula forceps; as the instrument enters the eye the loop falls down, and comes to rest on the sclerotic over the edges of the wound. When the forceps are withdrawn, and the fold of iris pulled out through the wound, the loop of silk is to be drawn into a knot, an

Method of tightening it.

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* Mr. Critchett on Iridesis, *Ophthalmic Hospital Reports*, vol. i. p. 220.

assistant seizing either end of the thread with a pair of cilia forceps (*vide* Fig. 31). The advantage of using forceps is, that it facilitates our taking hold of the ends of the silk and tightening them; it is difficult to manipulate under these circumstances with one's fingers, and we must carefully avoid dragging on the iris, otherwise we may detach it from its ciliary border and do irreparable harm.

Corneal wound must be small.

The opening in the cornea should only be sufficiently large to allow the introduction of the cannula forceps, otherwise the fold of the iris, after it has been tied, together with the ligature, may slip through the wound into the anterior chamber of the eye.

Advantages of iridesis.

The object of this operation is to displace the pupil, and bring it behind a healthy portion of the cornea, in those cases where the axis of vision is occluded by corneal opacity. Its assumed superiority over excision of the iris consists in this, that we can more accurately command the size of the pupil, and by not dividing the circular fibres of the iris the contractility of the aperture is retained, so that it responds to the stimulus of light.

3. IRIDECTOMY. **Operation.**

3. IRIDECTOMY.—The instruments required for this operation will be a stop-speculum, to keep the eyelids apart; a pair of fixing forceps, to steady the eyeball with; a broad lance-shaped knife, either straight or bent according to the direction in which we propose making the iridectomy; a pair of iris forceps; and lastly, curved scissors. Dr. Wecker's iris scissors are very useful in this operation. The patient having been placed in the recumbent position, it is, as a general rule, very advisable to get him fully under the effects of æther, so as to render him completely insensible; a stop-speculum is then to be adjusted. The surgeon, either in front or behind the patient, standing or sitting as he may find it most convenient to himself, seizes a fold of the conjunctiva, opposite the intended point of puncture, with a pair of fixing forceps, so as to steady the globe of the eye. He then thrusts the lance-shaped iridectomy knife through the sclero-corneal junction, at a point from ½ to 1½ lines behind the margin of the cornea, and thrusting the blade of the instrument steadily onwards, close in front of the iris,

Incision in sclerotic.

an opening about a quarter of an inch long is made in the sclerotic. The knife is then to be slowly withdrawn, so that there is no sudden rush of aqueous from the eye. If the anterior chamber is very shallow, the incision may best be made with a narrow-bladed cataract knife; there is less risk of wounding the lens than with a lance-shaped knife.

The surgeon, still fixing the globe of the eye with one hand, takes a pair of iridectomy forceps in the other; and if the iris does not protrude through the wound, he inserts the points of the forceps (closed) through the wound in the sclerotic, seizes a fold of the iris about midway between its ciliary and pupillary borders, and drawing the fold of iris out through the wound, an assistant cuts off the requisite amount of iris with a pair of scissors, quite close up to the edges of the wound in the cornea. In many cases of glaucoma after the opening has been made in the cornea, the iris protrudes through the edges of the wound: this is an advantage, for it enables us to seize a fold of the iris without inserting the forceps into the anterior chamber.

A fold of iris withdrawn and divided.

The fold of iris may be excised as above, or it may be cut off by either of the following modifications introduced by Mr. Bowman.* The iris is brought outside the chamber as above described, and divided with small scissors, on one side of the forceps, from the pupillary to the ciliary border, the forceps pulling it gently at the same time, so as to insure this complete division of it. The end held by the forceps is then torn from the ciliary attachment as far as the angle of the incision, and even dragged upon a little, so as to detach it beyond the angle, and then divided with the scissors quite close to the angle. The cut end then retreats within the chamber. The opposite side of the prolapsed part is then seized and dealt with exactly in the same manner. But however the iris is excised, great care must be taken that none of the iris is left between the lips of the wound, lest the healing process be imperfect, and subsequent irritation occur in the eye.

Bowman's method.

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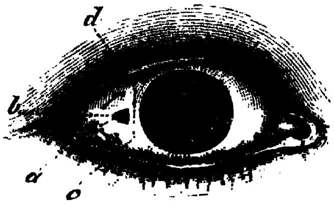
* *British Medical Journal*, 1862, vol. ii. p. 382.

This proceeding is shown in Fig. 31* I.; *a* the prolapse, divided into two portions at *b*. The lower portion is to be drawn, in the direction of *c*, to the lower angle of the incision, and snipped off. The upper portion is then to be drawn in the direction of *d*, and also divided.

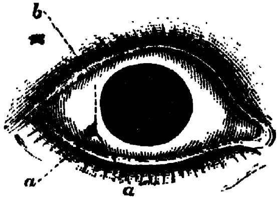
FIG. 31*, I.



A second method;

Instead of dividing it into two portions, the prolapse may be drawn to one angle of the incision, and partly divided close up to the angle; the other portion, being then gently torn from its ciliary insertion (slight snips with the scissors aiding in the division), and drawn to the opposite angle, is there to be completely cut off. This is illustrated in Fig. II.; *a*, the prolapse drawn down to the lower angle *a′* of the incision, where the inferior portion is to be divided, and the other drawn up in the direction of *b*, to the upper angle of the incision.

II.



when preferable.

The latter proceeding is perhaps to be preferred if there is much bleeding, for then it is not always easy to find the uncut portion, more particularly if it has slipped back between the lips of the wound. Either method will yield an excellent artificial pupil. The iris will be torn away quite up to its ciliary attachment, and the pupil will consequently reach quite to the periphery (Fig. III.).

III.

If there is any hæmorrhage into the anterior chamber, the fluid blood should be permitted to escape before coagulation. To effect this object a small curette should be inserted between the lips of the wound, slight pressure being at the same time made upon the eyeball with the fixation forceps, so as to facilitate the escape of the blood. The curette should not be inserted into the anterior chamber. If the blood does not flow off readily, it should not be forced out, but be permitted to remain, for it will soon be absorbed, particularly if a compressive bandage is applied.*

After-treatment.

The excision of the iris having been completed, the stop-speculum is to be removed, and the eye kept closed with a pad and bandage. If the patient suffers much pain subsequently to the operation, a few doses of morphia may be administered, but this is seldom necessary.

Cautions.

1. Let the opening in sclerotic be free.

In performing the operation of iridectomy, the chief points to attend to are,—1st, to make a free opening into the anterior chamber. With a wound less than a quarter of an inch long, it is almost impossible to complete the operation satisfactorily. A larger opening in the sclerotic can do no possible harm; the wound will heal in twenty-four hours; there is no fear of prolapse of the iris; and the more frequently I operate, the more convinced I am that a free opening is most essential to the success of iridectomy.

2. Be careful of lens and cornea.

2nd. Be careful to keep the point of the knife midway between the iris and cornea. By attending to this rule, both the lens and cornea will escape injury.

3. Detach the iris.

3rd. It is necessary that the ciliary attachment of the iris should, if practicable, be divided. The edges of the wound must be carefully freed from any portion of the iris; if tags of it are left between them, a troublesome fistula of the sclerotic may form, or continued irritation of the iris may be established.

4. Let alone any blood.

4th. Do not be over-anxious to remove the blood from the anterior chamber, after the operation, with a scoop; it is speedily absorbed, and in the meantime can do no great harm.

An upper opening preferable.

With regard to the position of the opening to be made in this iris, other circumstances being favourable, the superior section of the iris should be removed, as the upper lid covers the part to a considerable extent,

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[*] J. Soelberg Wells "On Glaucoma and its Cure by Iridectomy," p. 79. London, 1864.

and in this way lessens the blurring caused by the excessive amount of light which would otherwise reach the retina. In instances of ulceration or opacity of the cornea, the position of the iridectomy must be adapted to the circumstances of the case.

Instruments.

The knife employed in making the opening through the upper and inner part of the sclerotic, should have the blade bent at an obtuse angle with the shaft; an instrument of this kind facilitates the operation. But in making the lower and outer section, I prefer such a knife as one ordinarily uses in cases of linear extraction.

After-treatment.

The after-treatment consists in keeping a pad and bandage over the eye, and the patient should be confined to his bed for a few days. The wound in the sclerotic heals in three or four days. Nevertheless, it frequently happens, as in instances of inflammatory glaucoma, that a few days after the operation of iridectomy the tension of the eyeball increases, and continues in this condition for some time, after which the intra-ocular pressure diminishes, but the full advantages of the operation are not perfected, until it may be six weeks, or even two months' time after it was performed.

Iridectomy, its increasing usefulness.

Increasing use of Iridectomy.—It is remarkable how rapidly the advantages to be derived from the operation of iridectomy have been developed, and its employment extended, since its first introduction at a very recent period into ophthalmic practice. Iridectomy is especially called for in glaucoma, acute choroiditis, irido-choroiditis, rapidly advancing or intractable ulcers of the cornea, in occlusion of the pupil, and, in combination with other operative means, for the removal of the lens.

When called for.

Iridectomy, when the patient is under the influence of chloroform, and with a stop-speculum to separate the lids, is by no means a difficult undertaking, and it is an operation which every medical man, however small his field of work, should be prepared to undertake promptly, as being in some instances the only means at command for saving a patient's sight.

An easy operation.

ARTIFICIAL PUPIL WHEN REQUIRED.

CIRCUMSTANCES REQUIRING AN ARTIFICIAL PUPIL.—We may now proceed to consider the circumstances which necessitate an operation for an artificial pupil, and the condition of an eye which would lead us to choose one operation in preference to another for the end we have in view: this is evidently to make an opening through the iris behind a healthy portion of the cornea, when vision is prevented by a central opacity of the cornea, a closed pupil, or other obstruction to the passage of the rays of light to the retina.

Conditions necessary for success.

The conditions necessary, therefore, for the successful performance of this operation, are—First, that a portion of the cornea be transparent, and its curvature not greatly altered, otherwise the refraction of the rays of light which reach the retina may be so much deranged as to lead to serious impairment of vision. Secondly, if the iris is completely adherent to the lens or cornea, we can hardly expect to be able to form an artificial pupil. Lastly, the lens and internal membranes of the eye must be tolerably healthy, otherwise the making of an opening in the iris will scarcely improve the patient's condition.

Amount of sight tested.

We may generally form a tolerably accurate judgment as to the state of the retina under these circumstances, by holding a bright lamp in front of the affected eye. The degree in which the patient is conscious of the illumination will be our guide to the amount of retinal sensibility; if he cannot distinguish the existence of the flame it will be useless operating.*

Tension of eye.

The tension of the eyeball will also afford us valuable information as to the condition of the deeper structures. In many instances the globe will be found soft and hopelessly atrophied; in other cases its tension may be increased from intra-ocular pressure: in either case, our chance of success by means of an artificial pupil will be lessened.

1. Choice of operation in central opacity.

1. In cases of central opacity of the cornea, whether complicated with staphyloma or not, but obstructing the passage of light to the retina, it is well in the first place to apply atropine to the eye, and thus discover to what extent the pupil is dilatable. If the pupil expands freely, it will be advisable to make an artificial pupil behind a transparent portion of the cornea, and, if practicable, on the inner side of the original pupil. Should the cornea not be clear in this position, we

Iridesis, if pupil dilatable.

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* 'Iconographie Ophthalmologique," par J. Sichel, p. 451.

must make the artificial pupil behind the outer and upper section of the cornea; and failing this, behind the most healthy part of the cornea.

But if, in central opacity of the cornea, we find the pupil will not dilate at all, the iris being firmly tied down to the capsule of the lens or to the cornea, it will be necessary to employ the forceps in order to withdraw a fold of iris from the eye, which must then be snipped off by an assistant.

Size of new pupil.

With regard to the dimensions of an artificial pupil, this will depend much on the condition of the cornea; but as a general rule, we may endeavour to imitate nature in this respect, making one opening through the iris about the size of the healthy semi-dilated pupil.

2. In closed pupil from prolapse,

2. It may, however, be necessary to make an artificial opening through the iris under other circumstances than those of opacity of the cornea; as, for instance, after injuries or wounds of the cornea, where a prolapse of the iris has taken place into the wound and the pupil has been drawn into the cicatrix. Such an accident sometimes occurs after extraction of the lens. In cases of this kind, it will be well to use the forceps, excising a fold of the iris as nearly as possible in the axis of vision. To prevent any dragging on the iris during the operation, the opening in the cornea must be made well forward, in fact, as near as possible to the position of the artificial pupil, without being actually in front of it, and so obstructing the passage of the light.

excise a portion of iris.

Position of incision.

3. In closure from synechia.

3. Again, in cases where the pupil has been closed by neo-plastic growths, the result of iritis, it will be necessary to open a passage for the rays of light through it. I have already described the operation of corelysis (p. 320), employed in breaking down partial synechia, under the heading of iritis, because it often forms a very important element in the treatment of that affection, preventing a recurrence of the inflammation. But, as I then remarked, if the pupil is entirely closed, and atropine fails to dilate it, we must resort to the operation of iridectomy, removing a portion of the upper section of the iris; for it is not sufficient in this case simply to make a passage for the rays of light to the retina, we must also endeavour to prevent the occurrence of those glaucomatous

employ iridectomy.

changes which tend to absolute destruction of the eye.*

4. In zonular cataract.

Iridesis.

4. Lastly, an artificial pupil may be necessary in certain forms of zonular cataract, characterized by central opacity of the lens, its margin being perfectly transparent. A cataract of this kind has but little tendency to spread, and therefore it will be unnecessary to remove the lens.; but the pupil may be very advantageously displaced towards the margin of the lens, so that for all practical purposes his eye will be a very good one.†

Should a pupil be made when one eye is sound?

We are often consulted by patients having one sound eye, and the other damaged in such a way as to render an artificial pupil necessary for the perfection of vision; and the question arises as to how far it is advisable to operate on the diseased eye, when the patient sees perfectly well with the other one.

A possible squint the only objection.

Not a valid one.

As a rule, it is well to operate on the diseased eye, for in the first place we may, by this means restore binocular vision, and can most certainly enlarge the field of view by bringing both eyes into play. The only objection which can well be urged against this proceeding is that the eye operated on is apt subsequently to become either inverted or everted, being involuntarily turned in such a direction that the rays of light from the object under observation, passing through the artificial pupil, shall fall upon the macula lutea. To effect this if the pupil is normal in one eye, and eccentric in the other, one eye must evidently be rotated inwards or outwards, as the case may be, so that rays may reach the corresponding portions of the retinæ. But even supposing a squint to arise under these circumstances, we need hardly take this contingency into consideration when weighing the *pros* and *cons* of making an artificial pupil.

It will of course be necessary, before operating in cases of this kind, to ascertain the amount of vision the patient possesses with the diseased eye; it is useless interfering if it has no perception of light; in fact, we must take the precautions I have already detailed regarding these matters, and act in every way according to the rules laid down.

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* *Ophthalmic Hospital Reports*, vol. i. p. 207.

† *Idem*, vol. iv., p. 150: Cases and Remarks by Mr. Critchett.

Position and size of artificial pupil.

With regard to the size and position of an artificial pupil—First if the eye to be operated on is tolerably healthy, make a *small* opening in the iris; it prevents "blurring." Second, make the opening, if possible, behind the internal and inferior part of the cornea, otherwise in its external and superior part. Third, if both eyes are operated on, make the artificial pupils, if practicable, behind the corresponding parts of the cornea.

DISEASES OF ANTERIOR CHAMBER.

ANTERIOR CHAMBER.

Change of form.

THE ANTERIOR CHAMBER is formed in front by the cornea, and behind by the iris resting on the crystalline, and as the lens varies in size at different periods of life, the form of the anterior chamber is likewise subject to variation.

Change of contents.

CHANGES IN THE AQUEOUS.—I have already described the changes which the aqueous undergoes in cases of iritis (p. 298). It may be simply discoloured, as in jaundice, or more commonly its transparency is diminished by the effects of inflammation on the cells of the iris and posterior elastic lamina of the cornea. Pus may find its way into the anterior chamber from the cornea, iris, or choroid; and lastly, its watery elements may become mixed with blood, or a clot may form in it, hæmorrhage having taken place from either the iris or choroid. Under these varying circumstances, the dimness of vision is the result of injury or disease, of far graver consequence than the abnormal state of the aqueous, which is the immediate cause of it; the latter may quickly regain its normal condition, if the disturbing influences which have affected it are removed.

Filaria in aqueous.

FOREIGN BODIES IN THE ANTERIOR CHAMBER.—In the 16th number of the Indian Annals, I gave the details of two cases of *filaria papillosa* in the anterior chamber of the human eye, and other surgeons have described cases of a similar kind. There is no possibility of mistaking the appearance presented by entozoa of this kind in the anterior chamber, the filaria may be distinctly seen moving about in the aqueous. Entozoa in this situation excite violent inflammation of the iris and cornea, and probably abscess of the eyeball, unless they are allowed to escape from the eye. This may usually be effected without difficulty, by puncturing the cornea with a narrow-bladed knife, which is to be rotated edgeways as it is withdrawn from the eye, allowing the aqueous to escape with a gush, and with it the entozoon. Filaria are very frequently seen in the eye of the horse in many parts of India.

Other foreign bodies. Foreign bodies occasionally find their way into the anterior chamber, and falling downwards to its lower part may generally be extracted by opening the cornea, and seizing the substance with a pair of cannula forceps.

While performing any of these operations, it is most advantageous to have your patient under the influence of chloroform; and subsequently atropine should be applied to the eye, and the lids be kept closed with a pad and bandage for a few days.

IRIDO-CHOROIDITIS.

IRIDO-CHOROIDITIS. Definition. Stellwag von Carion remarks that this form of disease is characterized by having, in addition to the symptoms of iritis, a very great impairment of vision, and inflammatory opacity of the vitreous humour.

Pathology. From the anatomy of the parts it is evident that inflammation of the iris is likely to spread backwards to the choroid, or it may commence in the latter structure and extend to the iris. When the disease has been in existence for some time, it is difficult to ascertain whether it began in the iris or the choroid; but practically this is not of very much consequence, as the treatment will be the same in either case. We may, however, observe as a guide in this matter, that if the affection of the eye has commenced in the iris its structure is usually very much altered, being discoloured and attenuated, the early symptoms of the disease being referrible to iritis; but if the choroid was primarily involved, we shall have a more marked history of complications depending on changes in the vitreous humour, such as marked dimness of vision, bodies floating about before the patient's eyes, and ultimately the lens becoming cataractous, the opacity often commencing in its posterior pole.

Two forms. Cases of irido-choroiditis may for convenience of description be divided into two classes; although in practice they will frequently be found to run the one into the other, nevertheless the division is sufficiently marked in most cases to enable us to follow a definite line of practice appropriate to each form of the disease.

1. SEROUS IRIDO-CHOROIDITIS.

1. SEROUS IRIDO-CHOROIDITIS commences with loss of sight, usually in one eye. The patient complains of a cloud or film over the visual field of the affected eye, which increases day by day. He has little or no pain in the eye, but tenderness on pressure over the ciliary region; there is no marked photophobia. On examining the eye we shall notice slight subconjunctival injection, often limited to isolated segments of the scleral zone. The aqueous humour is turbid, and in some instances flakes of opaque matter may be detected floating in it. The posterior layer of the cornea is hazy, and dotted as in keratitis punctata. As the disease advances the iris is discoloured, the pupil sluggish, and tied down by synechia of greater or less extent to the capsule of the lens; in some cases the pupil is entirely closed by neo-plastic formations passing between it and the capsule. A few distended vessels may be seen coursing over the iris, and these are apt to give way and cause hæmorrhage into the aqueous chamber.

Symptoms.

Changes in iris

in dioptric media.

If the dioptric media of the eye are sufficiently transparent to allow of our examining its deeper structures, the vitreous will be found hazy with flocculent bodies floating about in it. The tension of the eyeball is normal or slightly increased.

Tension.

Advanced stages of disease:

As the disease advances the subconjunctival injection is augmented, and so also the tension of the eyeball; at the same time the patient's vision becomes more impaired. The synechia increases, and the fibrous structure of the iris is more and more disorganized, it becomes relaxed, and finally the "iris projects into the aqueous chamber irregularly, attaining a spongy appearance." This bulging forward of the iris is very marked, and is due to the collection of serous fluid behind it, forcing forward those attenuated portions of the iris which are not tied down to the capsule of the lens. In the meantime the neo-plastic growths about the pupil have been increasing, becoming organized and contracted, so that the pupil may be closed by a false membrane; it assumes an irregular shape, appearing like a minute tendinous spot in the centre of the bulging iris. When the disease has advanced thus far the tension of the globe will have

iris bulges forward.

Pupil closed.

become lessened. The iris undergoes degeneration, and the patient's sight is in fact almost lost, the globe rapidly undergoing atrophy.

Atrophy of globe.

2. PARENCHYMATOUS IRIDO-CHOROIDITIS. — In this disease the symptoms are from the first more severe than in the serous form above described; the pain and congestion of both the deep and superficial vessels of the conjunctiva are considerable, the tenderness over the region of the choroid is marked, and the vitreous is quickly and extensively involved. The iris is much discoloured, and pressed forwards towards the cornea, so that the anterior chamber is very narrow from before backwards, in consequence of the lens being pushed forwards by masses of parenchymatous materials similar to those described in the corresponding form of iritis; and, as I mentioned when speaking of iritis, these growths on the iris are apt to degenerate into pus; so in the form of irido-choroiditis now under consideration, an hypopion is from time to time noticed in the patient's eye, caused by the degeneration of the neo-plasma in the ciliary body. Lastly, the iris in instances of this disease is frequently closely bound down to the capsule of the lens by means of this neoplastic material when organized. As a result of the diseased action going on in the ciliary body and choroid, not only is the episcleral zone of vessels very marked, but numerous large and tortuous blood-vessels may be seen on the surface of the iris; there are, however, none of the irregular projections of the iris noticed in instances of serous irido-choroiditis, due to pressure of fluid from behind on degenerated portions of the iris; the iris is perfectly straight and even, although pressed forwards, it may be, close to the cornea.

2. PARENCHYMATOUS IRIDO-CHOROIDITIS.

Symptoms severe.

Pain on pressure.

Hypopion.

Closed pupil.

Iris vascular.

It is hardly necessary for me to remark that a diseased action, such as that I have now described, is hardly likely to confine itself to the iris and ciliary body; doubtless, in many instances, the abnormal action involves the choroid and retina, in hopeless and endless destruction.

Prognosis.—As in iritis, so irido-choroiditis, the prognosis will be more favourable in the serous than in the parenchymatous form of disease, because, as I shall subsequently explain, the former is more amenable to the beneficial influences of an iridectomy than the latter. But whatever the form of the irido-choroiditis,

Prognosis.

Most favourable in serous form.

the first point we should consider in forming a prognosis is as to the state of the patient's vision. We shall notice if he can see large objects—if he can count fingers held up before the diseased eye; if not, whether he can discern the flame of a candle in a dark room. Under the latter circumstance, we can give the patient but slight hope, for in all probability extensive lesion of the choroid and retina exists in addition to the irido-choroiditis; but if he can count fingers or other large objects held before his eyes, and the disease is of the serous variety, we may reasonably hold out to our patient hopes of improvement. We shall also be guided in our prognosis by the amount of atrophy the globe has undergone, for if the eyeball is soft and much shrunken we can hardly hope for amendment, although if its tension is only slightly diminished, there is no reason why it should not regain its normal condition after an iridectomy; in truth, it often does so.

From the amount of sight.

From the degree of atrophy.

Causes.

Causes.—The causes which give rise to irido-choroiditis are very similar, if not identical, with those which engender iritis, and these I have already noticed. Severe concussions or penetrating wounds of the eye may set up inflammation in this part, as also the entrance of a foreign body into the globe, or dislocation of the lens. Irido-choroiditis is consequently not uncommon after the operation of depression of the lens, or after extraction if lenticular matter is left in the eye. But a more common cause than any of the above is the presence of synechia binding the iris down to the capsule of the lens; this, by constantly dragging on the iris, keeps up perpetual irritation, which is in time propagated to the ciliary body and choroid, and thus a formidable attack of irido-choroiditis may be induced.

As in Iritis.

Traumatic.

Synechia.

Treatment.

Treatment.—Evidently as synechia is the most prolific source of the affection now under our consideration, it follows that in instances of the kind we must endeavour to break down the synechia. To effect this, we may in the first place resort to the instillation of a strong solution of atropine; this failing to dilate the pupil, we must perform an iridectomy.

Atropine.

Iridectomy.

With regard to iridectomy in cases of severe irido-choroiditis, it may be laid down, as a general rule, that we shall in the majority of cases have to resort to this operation; it is in fact frequently the only hope for the patient, and fortunately in some apparently most unfavourable instances of this dangerous form of disease, iridectomy has a marked effect.

It not unfrequently happens that, in attempting to perform an iridectomy in cases of irido-choroiditis, we find that the iris is so firmly bound down to the capsule near the pupil, that on withdrawing a fold of it for excision, it breaks away from its attachments to the capsule, leaving a narrow ridge of the iris in the former position of the pupil. An accident of this kind is of little consequence, but if inflammatory symptoms going on in the eye prior to the operation do not quickly subside, we may with advantage perform a second iridectomy from the other side of the eye, so that the opposite halves of the iris are cut off from one another. It is advisable under these circumstances, if possible, to cut away a portion of the upper and lower sections of the iris, so that the opening through it may be partly covered by the upper eyelid. Nor does it always follow that the excision of a second portion of the iris is sufficient for our purpose. In bad cases of irido-choroiditis we have Mr. Bowman's authority for operating and excising a third section of the iris.* One reason for this is, that it is not improbable that the space from which we have excised a piece of the iris on the first and second occasions may have been, or may subsequently become, filled in by uveal growths, preventing light from reaching the retina; nevertheless, these primary operations will have reduced the hyperaction going on in the part, so that subsequently to our third iridectomy the space occupied by the opening through the iris may remain clear; and thus the last operation is by far the most satisfactory, particularly in cases of serous irido-choroiditis. In the parenchymatous form of disease we cannot but fear, under any circumstances, that abundant neo-plasma will materially interfere with our best endeavours, and will occupy the space partially cleared by removal of a portion of the iris. In cases of this description we must not only remove a piece of the iris, but in addition

Directions for a second operation;

and a third.

Management of neoplasms.

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* *Ophthalmic Hospital Reports*, vol. iii. p. 230.

the neo-plastic growth behind it. The straight-hooked forceps are best adapted for removing such an iris; with this instrument portions of false membrane adhering to the posterior surface of the iris may be taken away, but their removal often endangers the lens; for this reason, and also because the lens pressing on the iris may add to the risk to which such an eye is exposed, Von Graefe advises the removal of the lens in addition to an iridectomy by means of the following operation:—

Graefe's operations; the removal of the lens.

He makes the flap, if the condition of the cornea permits it, downwards, avoiding, if possible, to wound the iris; but if the latter is greatly bulged forward, he passes the knife boldly through it, and in the latter case the capsule is already sufficiently divided to permit the ready egress of the lens. If this is not the case, or the iris has remained untouched, he introduces a pair of straight forceps or a hook, and removes or tears as much of the iris and membrane as is necessary to permit the exit of the lens. After the operation a compress is to be applied, firm at first, and then afterwards somewhat looser. There is generally only very slight reaction, so that the patients for the most part only want to remain in bed for a day or two, and five to seven days in a darkened room.

In some of the cases the condition of the iris begins to improve after the lens has been removed. The anterior chamber becomes wider, and some patients have a little better perception of light. In many cases the ciliary neurosis is also much diminished. For bleeding into the anterior chamber, a soft compress is best; sometimes the absorption of the blood may take as long as two to three weeks.

The iridectomy.

A month or six weeks after the extraction the iridectomy is to be made. Von Graefe makes a large linear incision, passes a large sharply-pointed hook perpendicularly through the tract of the membranes. If on traction of the hook a clear black pupil of middling size becomes apparent, and vitreous humour penetrates into the anterior chamber, he considers the dilaceration as sufficient. If this is not the case, a blunt hook or a straight pair of forceps should be introduced and the opening enlarged. The same will be necessary if a secondary cataract appears in the newly-made pupil. After this operation the cornea becomes plumper, and may re-acquire a good amount of curvature.

At first he was afraid that the pupils might in such cases close again, but this is fortunately not the case, and these instances form in this respect a most striking exception to those in which an iridectomy has been made without the previous removal of the lens.

SYMPATHETIC IRIDO-CYCLITIS. SYMPATHETIC IRIDO-CYCLITIS, or inflammation of the ciliary body, sometimes called "sympathetic ophthalmia," is another form of irido-choroiditis, and appears to be the result of morbid irritation in a diseased eye, conveyed by means of the ciliary nerves to the sound eye, inducing a disposition to congestion and the inflammatory proliferation of the tissues in the latter. This most dangerous and insidious form of disease is commonly induced by lesions in one eye keeping up persistent irritation; Causes. as, for instance, the irritation and irido-choroiditis brought about by a depressed lens, or a penetrating wound of the sclerotic involving branches of the ciliary nerves in its cicatrix. Synechia, however, alone is capable of keeping up so constant an irritation in one eye as to excite sympathetic irido-cyclitis in the other eye. Nor is it by any means in the active stages only of disease that the one eye thus injuriously affects the other: it often happens that a globe apparently atrophied and destroyed still remains sensitive, and is Often insidious. perhaps subject to recurrent paroxysms of pain; in cases of this description it is by no means rare to see sympathetic irido-cyclitis set up in the other eye. We have always to bear in mind the fact, that an eye impaired by certain forms of disease or accident may exercise, through what we call sympathetic nervous agency, a most pernicious influence over the sound eye.

We may conveniently describe the form of disease we are now considering under two heads—serous and parenchymatous irido-cyclitis.

1. Serous irido-cyclitis. 1. *Serous Irido-cyclitis.*—In the early stages of serous irido-cyclitis, probably the only symptom of which the patient complains is dimness of vision; everything appears as though seen through a mist, and these symptoms are more marked in a dim light, as, for instance, after sunset; in fact, so prominent a

Symptoms, when progress slow;

feature is this of the complaint that it is sometimes mistaken for night blindness. As the disease advances, the patient complains of opaque bodies floating about before his eyes. These symptoms depend on haziness and subsequent fluidity of the vitreous humour. There may be little or no pain in the eye, and the sclerotic zone of congested vessels may be wanting. The pupil responds but slowly, if at all, to the stimulus of light, and frequently takes a considerable time to act, on the instillation of strong mydriatics.

when acute.

In other cases the serous effusion takes place rapidly, and under these circumstances the intra-ocular pressure and tension of the eyeball being suddenly augmented, the patient experiences great pain in the eye and corresponding side of the head; the sight for the time being is almost completely destroyed. In these acute cases the posterior layer of the cornea becomes hazy, its epithelium degenerating into opaque, flocculent-looking masses, giving the cornea a speckled appearance; the haziness is often so dense that the fibrous structure of the iris cannot even be seen through it.

2. Parenchymatous irido-cyclitis;

Symptoms often slight at first.

Signs of iritis.

2. *Parenchymatous Irido-cyclitis* is more frequently met with as a result of morbid action in a diseased eye propagated to a sound one, than the serous form above described; and I cannot too strongly impress the fact, that the invasion of this most destructive affection of the eye is often very insidious. The diseased organ is probably complained of from time to time, more as an annoyance than as causing any great pain or inconvenience to the patient; it is perhaps tender on pressure, and neuralgia of the brow and temple is now and then experienced. Under these circumstances, it may be without the patient suffering any pain in it, we notice a slight amount of subconjunctival injection in the hitherto sound eye, and on close examination find the iris is discoloured, and its fibrous structure indistinct; it does not respond sharply to the stimulus of light, and the anterior chamber is perhaps diminished in depth. In other cases, besides these signs of trouble in the iris, the patient complains of pain in the eye, especially if pressure is made over the ciliary region, photophobia, lachrymation, and supra-orbital neuralgia. After a short time the pupil ceases to respond to light; and on atropine being

Synechia.

Atrophy.

dropped into the eye, we find posterior synechia has already formed, and this, rapidly increasing, glues the iris down to the capsule of the lens, the pupil being frequently closed by neoplastic growths, which may assume a yellowish colour. Corresponding changes occur in the stroma of the iris and choroid; their fibrous structure becomes atrophied and destroyed. The lens and vitreous participate in these degenerative changes, and the eye in too many cases is hopelessly and irrecoverably destroyed.

"Sympathetic irritation."

Symptoms.

Less dangerous.

There is another class of cases which we not uncommonly meet with in practice, of a milder nature than either of those above described; in fact, they may be called rather "sympathetic irritation" than sympathetic irido-choroiditis. In these cases, from injury or disease, a patient loses one eye totally or in part. It may be that he suffers no pain or irritation in the damaged eye; but from time to time, from overwork, or overfeeding, very probably the two combined, with excessive smoking, the sound eye becomes irritable and congested, the subconjunctival zone of vessels is injected, there is intolerance of light, and an aching pain over the brow, these symptoms being augmented by using the eye. The tension of the eyeball is normal, and the pupil responds to the stimulus of light. After a few days' rest, and perhaps a little judicious starving, the eye resumes its normal appearance, and functions, and the patient continues his work as usual. These cases are to be distinguished from sympathetic irido-choroiditis, in that they may continue for years without inducing any further ill consequences; but if we find in addition to these troubles that the patient has tenderness over the ciliary region of the sound eye, the tension of the globe being increased, and that his vision is becoming impaired—it may be only slightly hazy—and the accommodation less sharp than heretofore, perhaps the pupil also acting sluggishly, then we have no longer to deal with sympathetic irritation, but with irido-choroiditis in its early stages, and our prognosis even then will be a grave one in proportion to the advance made in these symptoms before the patient comes under our observation.

Causes.

Causes.—I have already observed that sympathetic irido-choroiditis most frequently arises from the presence of a foreign body, such as a piece of a gun cap, or

Foreign bodies.

some such hard substance, in one eye, exciting sympathetic hyperaction in the other eye through the influence of the ciliary nerves. Among these causes we must not overlook one too common in India—a dislocated lens, thrust down upon the ciliary processes by native "malls" in their operation for the cure of cataract. It would be well in these cases if the injured eye were destroyed entirely by suppuration, for an eye destroyed by abscess of the globe seldom excites sympathetic irritation in the other eye. This fact is accounted for by the assumption that in abscess of the globe the ciliary nerves or their terminal branches being destroyed *in toto*, they can no longer be a starting-point of hyperaction in the other eye.

Wounds.

Foreign bodies, however, are by no means the only cause of sympathetic irido-choroiditis; injuries of one globe, such as an incised wound of the sclerotic and choroid, as cicatrization proceeds, may involve some of the branches of the ciliary nerves and so set up sympathetic irritation. Staphyloma of the iris may in like manner induce this dangerous form of disease.

Inflammation.

Finally we must bear in mind that internal inflammation of an eye, however induced, is always a likely source of sympathetic irritation if accompanied by continued tenderness over the ciliary region of the diseased globe.

Prognosis. Mostly unfavourable.

The Prognosis of sympathetic irido-choroiditis is always most unfavourable, although in its early stages the removal of the diseased eye may possibly save the sound one; but when once structural changes have occurred in one eye consequent on irritation going on in the other one, we can have but little reasonable hope of saving the second eye. As a general rule, sympathetic disease spreads from an injured or diseased eye to the other one within a period of a few weeks or months, but it may happen that years pass over before this dangerous affection is called into activity in the second eye, or that it becomes so far advanced as to attract attention, and it is then very probably too late to remove the diseased eye. The operation of removal may be followed by temporary relief under these circumstances, but cannot be at all depended upon for the arrest of the abnormal action in the second eye.

Treatment.

Treatment.—I have in the above remarks, so repeatedly observed that the disease we are now considering has its point of departure in a diseased or injured eye, that we can readily understand the necessity of removing a diseased globe under these circumstances. As a general rule, therefore, the sight of one eye having been destroyed, and symptoms of hyperaction arising in the other, we should at once recommend the excision of the diseased globe (p. 76). Nevertheless, we cannot even then assure the patient that the disease will not progress in the other eye. It is the proper treatment to adopt, but by no means a specific against further mischief, and almost useless if structural changes and tenderness over the ciliary region have set in in the second eye.

Early excision of diseased eye.

The treatment of the eye in which disease has been established by sympathetic irritation is most unsatisfactory. We should endeavour to keep the pupil fully dilated with atropine, and the eye should be maintained in a state of perfect rest, the patient remaining in a dark room, and partaking only sparingly of food. By a soothing plan of treatment we may hope to quiet down the inflammatory attack from which the patient may be suffering, at any rate for the time being; but recur it is almost certain to do, and each attack adds to the damage already inflicted on the eye. Nor can we with any confidence fall back upon an iridectomy in instances of sympathetic irido-choroiditis; in the early stages of the disease it may perhaps be attempted, but I fear with but little hope of relief; in the latter stages the iris becomes so rotten, and firmly glued down to the capsule of the lens, that it breaks away when seized by the iridectomy forceps, and it is useless therefore attempting the operation.

Atropine and Rest.

Iridectomy seldom avails.

CHAPTER X.

DISEASES OF THE CHOROID.

Hyperæmia — Choroiditis disseminata — Choroiditis diffusa—Suppurative Choroiditis—Extravasation of blood—Atrophy—Glaucoma—Posterior Staphyloma —Tubercle—Wounds and injuries of the choroid—Detachment—Sympathetic irritation—Tumours.

HYPERÆMIA AND INFLAMMATION.

HYPERÆMIA.

HYPERÆMIA OF THE CHOROID.—Among dark-skinned races, the pigmented hexagonal cells prevent our seeing the healthy choroid with the ophthalmoscope.

Symptoms very obscure.

Passive hyperæmia of the choroid may occur without the patient being at all aware of its existence. Moreover, the tension of the eyeball is generally normal, the iris responds to the stimulus of light, and the dioptric media appear healthy; but from time to time the patient suffers from what he calls weak eyes: there is then some intolerance of light, and slight pain on pressure over the globe of the eye; the sclerotic zone of vessels is probably somewhat congested, and conjunctivitis may also exist. A case of this description is not unfrequently put down as an instance of sclerotitis, when in fact it depends upon hyperæmia of the choroid.

Hexagonal cells first removed.

One of the earliest alterations observed in dark-skinned people in hyperæmia of the choroid is the removal of the hexagonal cells of that structure. This change is of course only noticeable among coloured people. Although, generally speaking, these cells thus become disintegrated and destroyed in passive hyperæmia, in some instances, it seems to me, they are simply pushed back, from over the course of the distended vessels, and as the hyperæmia subsides, they recover their position, the parts returning to their normal state.

But in addition to these changes in the epithelial layer of the choroid, its pigment cells become compressed by the distended capillaries, and aggravated into dense masses; and from this condition they seldom seem to recover, remaining as patches of black pigment more or less closely adherent to the sclerotic. Whatever the office of these choroidal cells may be, we may be quite sure that changes, such as I have described, cannot occur without disturbance to the functions of the choroid.

Pigment cells of stroma compressed.

Causes.—Hyperæmia of the choroid appears at times to arise from exhaustion of the nerve fibres supplying its vessels, it may be from over-work or stimulation, or from debility. It is not an uncommon thing to be consulted by young men complaining of gradually increasing impairment of sight; they are weak, with a small irritable pulse, having pallid faces, and a nervous uneasy manner. On examining the eye with the ophthalmoscope, we notice under these circumstances that hyperæmia of the choroidal vessels is present, and some slight opacity of the vitreous may be observed, depending very probably upon exhaustion of the vaso-motor nerves.

Causes. Nervous exhaustion

In instances of this description it will be important to determine if over-work, disease, or venereal excesses are the cause of the hyperæmia, and our treatment must be directed towards the removal of any of these depressing influences, so as if possible to restore the tone of the nervous system, and thereby the contractility of the capillary network of the choroid.

from various causes.

Passive hyperæmia of the choroid may result from mechanical causes, as for instance, from pressure exerted on the veins of the part, or from more general disorder in the circulation, depending on disease of the heart. If from the former of these causes, the case will very probably be complicated with serous effusion into the retina, and a more or less extensive detachment of its nervous substance from the choroid, together with venous congestion. These changes most frequently follow syphilitic inflammation of the sheath of the vessels, or disease of the dura mater, or brain, and are very commonly characterized by intense head-

Mechanical obstruction in vessels,

ache, and symptoms indicating derangement of the nervous centre. In instances of hyperæmia of the choroid arising from disease of the heart, we shall usually have further evidence of the latter, in the general symptoms from which the patient suffers, pointing directly to impairment of the cardiac functions; and any suspicions that may have been formed will be confirmed or removed by the aid of the stethoscope.

or heart.

Intestinal irritation.

Besides taking all these circumstances into consideration in attempting to determine the causes which give rise to hyperæmia of the choroid, it will be necessary to inquire into the state of the digestive organs; sympathetic irritation propagated from the alimentary canal to the eye being perhaps at the root of the mischief.

Disorders of accommodation.

Lastly, I may mention that hyperæmia of the choroid sometimes arises from defects in the accommodation of the eye, the patient making an unnatural effort when looking at near objects. The constant strain on the muscular apparatus of the eye which is thus kept up, induces passive congestion of the choroid.

Treatment.

Remove the cause.

Treatment.—I would strongly insist on the point, that a satisfactory opinion as to the cause of the disease must be arrived at, before we can safely prescribe any plan of treatment for its cure. Our duty will then be to select such measures as may seem best adapted to correct the more remote conditions of ill-health from which the patient may be suffering, and on which the choroidal affection depends. Any consideration of these would lead us too far from our present subject.

Counter-irritation, cold, rest.

As regards local treatment, the cold water douche, rest, and counter-irritation, will form very valuable adjuncts to any general remedial agents we may think best suited to the case. And where the hyperæmia is dependent on disorder of accommodation, the rational treatment will be, of course, to supply the patient with glasses adapted to correct it.

Choroiditis Disseminata.

Subacute and latent character.

Choroiditis Disseminata depends upon partial or local changes going on in the choroid, often of a subacute character, so that the patient complains of no marked symptoms during the early stages of the disease, and, in fact, may be completely unconscious of its existence. This may continue until the disease has advanced so far as to interfere with the due supply of blood to the choroid, when degenerative changes will be induced in the vitreous, and render the patient's sight more or less dim.

Analogous to plastic iritis.

The pathology of this affection of the choroid seems to be analogous to that of plastic iritis, already described: neo-plastic elements form in the choroid, and as they become organized, the tissues among which they grow are compressed, the circulation through the vessels is impeded, and the part becomes atrophied. Although it is necessary to describe these various diseases of the choroid as distinct and separate affections, I need hardly observe that in practice we find the retina and iris almost invariably implicated, if the choroid is at all extensively diseased.*

Symptoms.

Muscæ.

No pain.

Symptoms.—The patient usually applies to us on account of impaired sight, and complains of an appearance of cobwebs, or flocculent bodies, floating about in the field of vision. There is little or no pain in the eye, and the cornea, conjunctiva, and sclerotic are generally perfectly healthy; and unless in the advanced stages of the disease, the iris appears normal, and the pupil responds to the stimulus of light. At a subsequent period the iris becomes implicated, and we then have superadded to the symptoms of choroiditis those of plastic iritis. The sclerotic zone of vessels, which is often congested from an early stage of the disease, is sure to be well marked when the morbid action has passed to the iris.

White patches in choroid.

On examining the eye with the ophthalmoscope we shall observe in the early stages of the disease generally towards the ora serrata, numerous small specks of a greyish-white colour; these gradually increase in size, and encroaching, or rather forming, towards the fundus of the eye, they appear as whitish patches behind the retina. As the disease advances the choroid becomes atrophied, and then the glistening white sclerotic may be seen in irregular-shaped patches, the retinal vessels coursing over them. The circumference of these white patches is generally surrounded with a border of black condensed pigment.

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* "Maladies des Yeux," par L. A. Desmarres, tom. iii. pp. 405, 406.

If the disease advances unchecked, the patches of neo-plastic formation increase in size, until, as before remarked, by materially interfering with the circulation of blood through the choroid, the nutrition of the lens and vitreous is impaired.

Flocculi seen in vitreous.

The appearance of flocculi in the field of vision under these circumstances, may be due either to the presence of small particles floating about in an already fluid vitreous, or, in the early stages of the disease, to pressure on the retina; occasioned by the swollen choroid. Should pressure of this kind be limited to a part of the retina in or near the axis of vision, the patient often complains of a black spot being constantly present in the visual field, which is most troublesome to him when reading or writing—a *scotoma*, as it is called.*

Scotoma.

Causes. Syphilis.

Causes.—The most frequent cause of this affection of the choroid is syphilis, either acquired or hereditary. The iris may be the original seat of the disease, the abnormal action spreading backwards from it to the choroid; under these circumstances the train of symptoms will be very complicated; but if the dioptric media are sufficiently clear to enable us to see the fundus of the eye with the ophthalmoscope, all doubt as to the nature of the case will be removed. This affection of the choroid has been observed to follow some of the low forms of fever.

Low fevers.

Prognosis.—The course pursued by choroiditis disseminata very much depends upon the progress the disease has made before it is brought under treatment; the damage once done to the choroid by neo-plastic growths can never be repaired; so that if the latter are extensive, and a considerable portion of the circulation through the choroid is impeded by them, it is more than probable that atrophy of the globe will ensue, in spite of all our efforts to stay the degenerative changes. Formations of this kind occurring in the choroid, of necessity impair the functions of the retina, consequently, the progress of a case depends to a great extent upon the position of the neo-plastic growths with reference to the axis of vision. If we are fortunate enough to see the case when the patches of

Damage irreparable.

May cause atrophy of globe.

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* Cases reported by Mr. Moon, from Mr. J. Z. Laurence's practice: *Ophthalmic Review*, April, 1867, pp. 280, 282.

neo-plastic tissue are inconsiderable, we may often stay the further progress of the disease, and thus preserve the eye.

Treatment.
Good food, pure air.
Mercurials.
Tonics.
Atropine.

Treatment.—In syphilitic cases the patient must be well fed, have plenty of pure air and exercise, so as to bring the nutritive functions into good working order; and in addition, bichloride of mercury and iodide of potassium should be perseveringly administered. The mercurial vapour-bath may often be employed with advantage. Counter-irritation, in the shape of a blister, or an issue opened in the skin of the temple, is often of considerable use. If the patient is recovering from fever, we must chiefly rely on iron and quinine, combined with a generous dietary, not neglecting counter-irritation. The pupil should be fully dilated with atropine in all cases of choroiditis.

CHOROIDITIS DIFFUSA

CHOROIDITIS DIFFUSA.—This affection of the choroid is described by M. Wecker as parenchymatous choroiditis, the disease resembling in every respect parenchymatous iritis.

Commences in the vessels.
Condylomata appear in the choroid.

In the first instance, we may observe changes taking place along the outer walls of the larger choroidal vessels; they appear as if lined by a white streak when seen with the ophthalmoscope. This border surrounding the vessels consists of organized neoplastic tissue, and is the product of the proliferating process, which usually commences in the cells of their adventitious coat. The diseased action thus set up in the part is apt, under certain circumstances, to extend itself rapidly in the neighbouring connective tissue, sometimes involving the whole fibro-cellular web of the choroid, in which condylomatous growths make their appearance. As these increase in size, they push the retina before them, advancing rapidly towards the vitreous chamber, so that ultimately the fundus of the eye presents a nodulated appearance of a greyish-white colour, over which the remains of the retinal vessels may be traced.

Pupil dilated.

This form of disease is most commonly met with among young and delicate children, frequently the offspring of syphilitic parents. Under these circumstances the patient's eye probably presents the following appearances: The pupil is dilated, and of a greenish colour; the tension of the eyeball is increased, Globe enlarged, and tense; fundus nodulated.

the globe being evidently enlarged. On looking through the pupil we may notice that the fundus is occupied by a nodulated greyish-white mass, with a few vessels coursing over its surface; by transmitted light these appearances are well seen.

Sight quickly lost.

The sight is, of course, speedily destroyed in the diseased eye, but the patient suffers from little, if any, pain in it, the distension of the globe being very gradual; moreover, the sclerotic undergoes fatty degeneration in consequence of the disease in the choroid, and so yields to the intra-ocular growth, preventing any considerable increase of tension.

Instances of this kind are likely to be mistaken for malignant disease. The patient's general health, however, remains unimpaired, and the advance of the disease is very slow indeed; moreover, the growth appears almost non-vascular; these characters are sufficient to exclude the idea of cancer.

Eye destroyed.

As these pathological changes in the choroid progress, the lens and retina become hazy, and the whole eye may suppurate; or slowly-advancing degenerative changes occur, and the eyeball becomes atrophied and destroyed. It sometimes happens that these condylomatous growths in the choroid become metamorphosed into a true bony structure.

Symptoms.

No pain.

Impaired sight.

Appearance of the eye.

Symptoms.—As the progress of this affection of the choroid is usually very slow, its early stages are unaccompanied by pain, and gradually increasing impairment of vision is the symptom principally complained of by the patient. The eyeball slowly enlarges, and the whitish growth at the back of the eye, already described, may then be seen through the dilated pupil by means of the unaided eye, and still more clearly with the ophthalmoscope. Opacity of the lens and vitreous supervenes, and ultimately the eye is destroyed, either by general suppuration, or ulceration and destruction of the cornea.

Causes obscure.

Causes.—These are very obscure: probably inherited syphilis is the most frequent cause of the disease, but it has been observed to follow an injury to the eye in feeble and ill-nourished children.

SUPPURATION.

SUPPURATIVE CHOROIDITIS.—Suppuration may result from either of the forms of inflammation already described, but more commonly comes on after wounds or injuries of the eye. We meet with cases following the operation of reclination, the irritation of the lens exciting violent inflammation in the choroid.

After wounds.

The changes going on in the fundus of the eye, in instances of suppuration of the choroid, cannot be observed with the ophthalmoscope, because the diseased condition of that structure very soon impedes the circulation of blood through its vessels, and degenerative changes in the vitreous, lens, and cornea supervene, which entirely prevent any but scattered rays of light from reaching the fundus of the eye.

Progress concealed.

Symptoms.—Suppuration of the choroid is marked by the eyelids becoming swollen, red, and œdematous; there is intense pain in the eye and side of the head, greatly increased tension of the globe, deep injection of the conjunctival and sclerotic vessels, a muddy state of the aqueous, haziness of the cornea, lens, and vitreous, and insensibility of the iris either to the influence of light or to mydriatics. As the disease advances pus finds its way into the anterior chamber, and suppuration of the cornea generally supervenes; ultimately the cornea sloughs, the contents of the eye are evacuated, and the globe shrivels up and recedes into the orbital cavity.

Pain, tension, injection.

Pupil inactive.

Pus in ant. chamber.

Cornea sloughs.

Cases of this kind might in fact with propriety be called abscess of the globe of the eye, rather than suppuration of the choroid, for in truth the disease involves all the structures constituting the globe of the eye; but as the inflammatory action commences in the choroid, it may be well to consider these instances as examples of suppuration of that structure. Moreover, pus may appear in the choroid without the disease advancing to absolute destruction of the globe of the eye, though probably suppuration can hardly take place in that situation without being followed by atrophy and loss of sight.

All the structures involved.

Eye or sight lost.

Treatment.—This will depend very much upon the cause of the disease: if arising, for instance, from the presence of a dislocated lens or some other foreign body in the eye, it will probably be well to remove the lens, making a free opening through the cornea and excising a considerable portion of the iris. But if the inflammatory action has proceeded so far as to cause general inflammation of the globe, the most efficient

Treatment.

Remove a dislocated lens,

or the eyeball.

treatment we can then adopt will be to remove the eyeball at once.

I hardly think it likely that any general or local remedies will stay the progress of suppuration, when once it has commenced in the choroid; leeches, mercury, iced compresses, and lowering remedies are recommended by those who believe that these means control the suppurative process; but I have great doubts of their efficacy, at any rate in cases of this kind.

EXTRAVASATION OF BLOOD.

EXTRAVASATION OF BLOOD into the choroid frequently occurs in choroiditis, the clots passing through the same changes as those described in similar affections of the retina. The effused blood, if poured out in any quantity, generally collects in patches of various sizes behind the elastic lamina, and completely hides the vessels and pigment-cells of the choroid. The nervous tissue of the retina, however, can be traced over the patches, and more particularly the retinal vessels; these, together with the remains of the hexagonal cells of the elastic lamina, are sufficient landmarks to guide us in the determination of the seat of hæmorrhage, and in distinguishing extravasations of blood into the choroid, from those into the retina.

Distinguished from retinal hæmorrhage.

GLAUCOMA.

Before entering upon the subject of glaucoma, it may be advisable to make a few remarks upon the excavation of the optic disc, which so constantly attends this form of disease.

EXCAVATION OF OPTIC NERVE.

EXCAVATION OF THE OPTIC NERVE simply means that the optic papilla is thrust backwards from its normal position, and consequently, if with the ophthalmoscope the vessels at the margin of the excavated disc be brought into focus, it is evident that their continuation over the papilla cannot be distinctly seen till the accommodation of the observer's eye is altered, the vessels on the disc being on a plane posterior to those of the retina. Conversely, if the observer alters the focus, so that the papilla is accurately defined, the vessels passing over the retina of the eye will be indistinct, because the latter are on a plane anterior to those crossing the papilla. Again, if the retinal vessels be traced up to the margin of the disc,

Vessels interrupted at margin of disc.

they appear to terminate there in "beak-shaped points," and their continuation over the papilla will seem to be interrupted and displaced, as shown in Fig. 1, Plate VII.

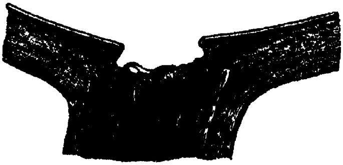
Explanation of the appearances.

The explanation of this is, that the vessels having arrived at the edge of the excavated disc, dip down over its margin, and in their course along the sides of the excavation cannot be seen by rays of light falling perpendicularly upon the disc; but as they pass over the bottom of the excavation they are again visible, although evidently on a plane posterior to the retina. If, however, the patient is made to turn his eye upwards or downwards, and the light from the ophthalmoscope be thrown obliquely upon the disc, so as to illuminate the sides of the depression, the vessels may be traced throughout their course; unless, as sometimes happens, the choroidal margin of the disc bulges very much inwards, like a rock overhanging a precipice, when the vessel, winding round the projection, must be entirely hidden from view till it reaches the bottom of the excavated papilla.

Causes.—Excavation of the optic nerve may arise from various causes, and First, from glaucoma, or pressure excavation; Secondly, from congenital malformation; Thirdly, from atrophy of the optic nerve.

1. Excavation of papilla in glaucoma.

FIG. 32.



1. In glaucomatous excavation, the whole of the disc is involved, and its sides are precipitous; this condition of the parts is shown in section in the annexed figure. The vessels may be seen at the margin of the disc, terminating as it were in hook-shaped extremities, represented in Fig. 1, Plate VII. The colour of the optic disc is changed, its central part is white and glistening, and this is surrounded by a shadow thrown by the walls of the disc into its excavated portion; the shadow varies with the depth of the excavation. In addition to these changes of the papilla, other conditions will be noticed hereafter in the fundus of the eye, which are pathognomonic of glaucoma.

2. In congenital malformations.

2. In cases of excavation of the papilla arising from congenital malformation, the entire disc is never in-

volved. I have seen several congenital cases in which the whole of the disc was excavated with the exception of a narrow border at its circumference; so that its choroidal edge was normal, and within this was a rim of the papilla, the remainder of it being excavated; but these cases are rare, compared to those congenital cases in which only a small portion of the disc is involved in the excavation. The depression of the optic disc under these circumstances is surrounded by a reddish zone, and the edges of the cup are usually slightly sloping. And with the exception of the excavation of a portion of the disc, the fundus of the eye is healthy, and its tension normal. Malformations of this description do not give rise to any subsequent changes, though, of course, an eye in this condition is by no means exempt from an attack of glaucoma, or any other form of disease to which it is subject under ordinary circumstances.

3. In atrophy of papilla.

3. Lastly, excavation of the disc, arising from atrophy and retraction of the optic nerve, is marked by atrophy of the elements of the optic nerve and its vessels, so that the colour of the papilla is changed to a greyish-white tint. In the atrophic form of excavation there is a comparatively slight amount of depression of the papilla, its sides sloping down gradually from the circumference towards its centre. The vessels may therefore usually be traced throughout their extent; but when the branches coursing over the fundus of the eye are in focus, those passing over the disc will appear very slightly out of focus, until the accommodation of the observer's eye is altered; but cupping of the optic disc, due to atrophic excavation, can hardly be made out unless by means of the direct method of examination.

Glaucoma.

Glaucoma.—We may proceed to consider the two varieties of the malady:—1. Primary Inflammatory Glaucoma. 2. Glaucoma Simplex.

1. Primary Inflammatory Glaucoma.

1. *Primary Inflammatory Glaucoma.*—In this form of disease the morbid phenomena commence in the uveal tract; as this regulates the intra-ocular fluids, irritation of it may lead to excessive secretion and increased tension of the eyeball. We may perhaps best form an idea of the pathology of the disease by combining the views of Professors Stellwag v. Carion and Donders, as to the conditions which they suppose

Pathology.

to be fundamental in these cases. The latter holds that glaucoma depends on neurosis of the secretory nerves of the eye, and the former, that a primary rigidity of the sclerotic produces the feeling of hardness of the globe of the eye noticed in instances of glaucoma.*

Increase of vitreous from neurosis,

with rigidity of sclerotic.

It is a well-known fact that section of the fifth pair of nerves causes excessive softness of the globe of the eye, and on the other hand, that excitation of these nerves increases the serosity of the vitreous, and so augments the intra-ocular tension. Supposing, therefore, that from unknown causes excitation of the fifth nerve occurs, and augmentation of the contents of the vitreous chamber takes place; then if, as Professor von Carion asserts, the sclerotic at times undergo similar changes to those observed in the fibrous coats of arteries, by which they become stiff and atheromatous, it is evident that increased intra-ocular pressure from the former cause would, under these circumstances, induce the phenomena characteristic of glaucoma.†

Symptoms.

Symptoms.—Glaucoma seldom attacks a person under forty years of age, and is more common among women than men.‡ In the first instance the patient complains of rapidly advancing presbyopia; he finds that month after month he has to increase the distance between his eye and the book he may be reading, in order to see the letters distinctly. The reason of this is, that the power of accommodation is in a great measure destroyed by changes going on in the choroid, which, though often hardly sufficient to cause any greatly increased tension of the globe, may, nevertheless affect the nerves of the ciliary muscle, so that the muscle can no longer act on the lens, and render its anterior surface sufficiently convex to bring divergent rays of light to a focus on the retina.

Advancing presbyopia.

Impairment of the field of vision.

The patient also complains of defect of sight, which on inspection may be found to be partly due to contraction of the field of vision, generally commencing on the inner or nasal side of the eye. By carefully examining the state of the patient's eye we shall probably discover that not only is his field of vision contracted, but very probably that certain portions of the retina are insensitive to the stimulus of light.

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* "Illustrations of some of the Principal Diseases of the Eye," by H. Power, F.R.C.S., p. 414.

† Donders on Glaucoma; "Report on the Heidelberg Ophthalmological Congress;" *Ophthalmic Review*, vol. ii. p. 189.

‡ For statistics on this subject, *vide Ophthalmic Review*, vol. i. p. 234.

Periodical pain.

On inquiry, we shall find that our patient has suffered from uneasiness, and often from a considerable amount of pain, of a periodic character, situated over the eyebrow and along the side of the nose. This pain, which is due to exacerbation of the choroidal congestion, and consequent augmentation of the tension of the eyeball, usually comes on towards evening, and lasts for a few hours, the patient's sight becoming misty during the paroxysm. The degree and character of this pain are uncertain; in some cases it is very intense, while in others it is trifling. Another symptom, noticed at an early period of the complaint, is that the patient sees a halo surrounding the flame of a candle, or any other luminous object in front of him.

Halo.

Tension increased.

Congestion.

In the early stages of glaucoma, the tension of the eyeball is only slightly increased, and this is most apparent towards evening; subsequently the increased tension becomes permanent, and varies according to the stage of the disease. We shall probably notice several enlarged vessels coursing over the sclerotic. The aqueous appears muddy, rendering the fibres of the iris indistinct. The state of the pupil will be found to vary according to the progress which the affection has made; at an early stage it acts sluggishly on the stimulus of light, but as the disease advances it gradually becomes less active, until at length it remains widely dilated and quite insensible to light.

Pupil inactive.

Retinal veins dilated.

Pulsation.

On making an ophthalmoscopic examination, the vitreous will be discovered to be somewhat hazy, and the retina hyperæmic, with its veins tortuous and deeply congested. The arteries in the early stage of the disease are normal, and subsequently perhaps slightly contracted; in both sets of vessels a distinct pulsation will be noticed, or, if it does not already exist in the arteries, it may be induced by slight pressure with the finger on the eyeball. The only change observable in the optic disc at this period is,

Papilla slightly cupped.

that its choroidal margin is rather prominent; except in cases complicated by congenital staphyloma of the papilla, in which, of course, the excavation will be more marked in consequence of the bulging backwards of the lamina cribrosa. As the disease advances, the vessels of the choroid will be found uniformly congested, but blurred and indistinct, from effusion into its substance.

Progress:

All symptoms intensified.

Cornea insensible.

Pupil dilated, greenish.

These symptoms having lasted for a longer or a shorter period, they all become perhaps suddenly augmented, it may be in a single night; more often, however, the severity of the premonitory symptoms gradually advances; the tension of the eyeball increases, the globe becomes hard, and the ciliary neurosis intense. The cornea is hazy, and its sensibility is diminished from compression of the ciliary nerves. The dimness of vision increases, the pupil is dilated and stationary; the lens is apparently of a green colour. This last appearance arises from the lens itself assuming a yellowish hue, while the aqueous becomes of a bluish tint, the combination causing the green colour, which at one time was supposed to be pathognomonic of glaucoma, and gave rise to its name. The episcleral tissue and conjunctiva appear thickly injected; the latter is often swelled and actually chemosed.

Venous congestion of fundus.

Further changes hid.

Disc deeply cupped.

If now the eye be examined with the ophthalmoscope, the cornea and lens remaining sufficiently transparent to allow of the rays of light reaching its fundus, the retinal veins will be seen to be very tortuous and greatly congested; they are sometimes beaded. The calibre of the arteries, on the other hand, is contracted, and a pulsation may be noticed in both sets of vessels. The fundus of the eye is of a brickdust colour, owing to the capillaries of the retina and choroid being uniformly congested; and spots of extravasated blood are not uncommonly noticed both in front and behind the elastic lamina. As the disease advances the dioptric media become hazy, and it may be impossible to see the further changes that take place in the fundus of the eye. The nervous structure of the papilla becomes atrophied, and the disc is cupped, the lamina cribrosa protruding backwards, so as to occupy a plane posterior to that of the sclerotic. A few days, or even hours, may complete the picture of glaucoma. But, as a general rule, a remission in the symptoms takes place, and a succession of such attacks follow at longer or shorter intervals, until the eye is destroyed. But we must bear in mind the fact that one single intensely violent and continued attack of this kind may complete the mischief. The disease having run its course, the pain abates, but the eye is lost as an optical instrument.

2. Glaucoma simplex. Very insidious.

2. *Glaucoma Simplex* is a very insidious disease. The external appearance of the eye is healthy, as is also the iris and refractive media. The patient complains of little or no pain, and the only constant symptoms noticed are the steadily increasing presbyopia, which after a time convex glasses fail to relieve, moreover there is contraction of the field of vision, together with augmented tension of the eyeball, which, though scarcely perceptible at the commencement of the attacks, becomes, after a time, a marked feature in the case.

The changes in the fundus of the eye progress at an equivalent rate, and frequently in both eyes at the same time; they are much the same as those observed in inflammatory glaucoma, and the termination of the disease is similar—namely, stony hardness of the globe, dilated pupil, opaque lens, a hazy anæsthetic condition of the cornea, and total loss of vision.

Consecutive glaucoma.

Glaucoma, as I have before remarked, may follow various diseases of the eye; as, for instance, cases of irido-choroiditis, occlusion of the pupil, diffuse keratitis and anterior staphyloma of the cornea: it occasionally occurs after wounds of the lens, or from irritation induced by the presence of a dislocated lens in the vitreous chamber. The glaucomatous changes in the eye, under these circumstances, pursue precisely the same course as I have already described—the hardness of the globe of the eye and cupping of the optic disc being characteristic of the disease.

Prognosis.

Prognosis.—The prognosis in cases of glaucoma cannot be doubtful. In time it is sure to lead to blindness in the affected eye, and in all probability the second eye will follow in the same course if the disease be allowed to run on. Provided, however, the glaucoma is in its premonitory stage, and the intervals between the attacks of pain and other symptoms are well marked, we may, by means of an

May be arrested by Iridectomy.

iridectomy, stop the progress of the disease; but by no other method of treatment can we hope to arrest its advance. The question may arise as to when we are to perform iridectomy. I think, as a general rule, it may be said iridectomy should be resorted to as soon after we have diagnosed the disease to be glaucoma as possible. But provided the intermissions of pain are complete, and the patient's sight hardly impaired, we need be in no hurry to operate; nevertheless, under these circumstances, warning our patient that at any moment an operation may be necessary, if the pain in the eye and brow, together with the other symptoms, declare themselves rapidly and with intensity. In cases therefore of inflammatory glaucoma, we may give a favourable prognosis, provided an iridectomy is performed before the structures of the eye have been permanently damaged; it matters not how acute the symptoms may be. The effects of an iridectomy for the cure of glaucoma, are as regards the improvement of sight gradual, and do not reach their maximum until some two months after the operation. In the later stages of glaucoma, and in cases of glaucoma simplex, the curative action of an iridectomy on the diseased eye are very uncertain. And in instances of secondary glaucoma, the good effects of the operation are still more doubtful. In complete glaucoma, unless to relieve pain, an iridectomy is useless.

Treatment. Iridectomy in early stages.

Treatment.—With regard to the treatment of glaucoma, there can be no doubt whatever that iridectomy, if practised sufficiently early, will cure the disease. In making this assertion, it must be clearly understood that by iridectomy I do not mean simply excision of a portion of the iris, however large it may be;—the operation consists in the successful removal of a section of the iris, together with its ciliary attachments. In certain cases of sloughing ulcers of the cornea, in which iridectomy is recommended, all that is requisite is to remove so much of it as will prevent the secretion of the normal amount of aqueous, and thus, by diminishing the pressure from behind, prevent the corneal tissue being stretched, and ultimately forced into a staphyloma. But in glaucoma more than this must be done; I was formerly in the habit of puncturing the cornea time after time in instances of this disease, and allowed the aqueous to escape, thus relieving the

The operation must be complete.

tension of the eyeball, without the slightest permanent benefit to the patient.

Mr. Hancock's operation.

I may mention in this place Mr. Hancock's operation for the division of the ciliary muscle, which he recommends in cases of glaucoma.

Mr. Hancock* thus describes his operation:—"A Beer's cataract knife is introduced at the outer and lower margin of the cornea, where it joins the sclerotica. The point of the knife is pushed obliquely backwards and downwards, until the fibres of the sclerotica are divided obliquely for rather more than one-eighth of an inch; by this incision the ciliary muscle is divided, whilst if there be any fluid accumulated, it flows by the side of the knife."

POSTERIOR STAPHYLOMA.

POSTERIOR STAPHYLOMA, OR SCLERO-CHOROIDITIS POSTERIOR.—In the majority of cases of myopia the fundus of the eye presents the following appearances:—If the observer's attention be directed towards the entrance of the optic nerve, he will there remark a white figure enclosing the outer margin of the nerve. In the early stages this figure is sickle-shaped, its concave margin in a certain degree coincident with the margin of the nerve-disc, while its convex margin looks towards the posterior pole of the eyeball.

A white crescent borders the papilla.

Extends irregularly.

As the disease progresses the white figure continually increases, so that its outer border extends farther from the nerve, and the whole patch changes its sickle-shaped outline in various ways; sometimes extending itself outwardly, and assuming the aspect of a horizontal band proceeding from the papilla; sometimes spreading upwards and downwards, and appearing as a white figure of very variable outline surrounding the outer border of the nerve, and separated from the surrounding fundus by an angular and indented margin. Lastly, the degeneration may also encircle the inner side of the nerve-entrance, so that the latter appears as an island enclosed in a white, or sometimes a bright green-coloured surface, the outer part of which, however, is always more developed and broader than the inner. The light reflected from the diseased surface exceeds every other ocular reflex in its intensity, and

Reflects brightly.

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* *Ophthalmic Hospital Reports*, vol. iii. p. 18.

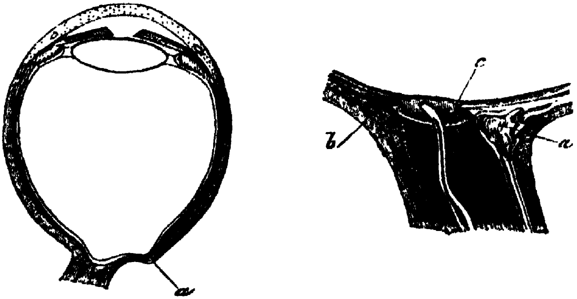
is much brighter and whiter than that from the optic nerve; so that the latter appears comparatively less illuminated, and of a dull grey or reddish tint.*

Pathological Anatomy.—The pathological changes which induce this condition of the parts have long been a subject of controversy, and in attempting to explain them we must in the first instance refer to the anatomy of the structures involved. We may, however, remark that posterior staphyloma is frequently a congenital, and also an hereditary affection.

Anatomy of optic sheath.

Some thirteen years ago Professor Donders pointed out the fact that the sheath of the optic nerve is divided into two parts (Fig. 33); the outer (*b*) runs into the sclerotic, and the inner (*c*) envelopes the trunk of the nerve as far as the choroid; the two are separated by loose connective tissue (*a*). Professor Donders considered that the choroid becomes atrophied to a certain extent round the optic disc, and that the inner layer of the sclerotic, bulging backwards at this point, gives rise to the appearances above described.†

Fig. 33.



Eyeball elongated backwards.

This explanation was confirmed by the fact that eyeballs affected with posterior staphyloma, after removal, were observed to project backwards at the part corresponding to the white crescent seen with the

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[*] Carter's translation of Zander on the Ophthalmoscope, p. 179.

[†] "Archiv. für Ophthal.," B. i. Abth. ii. p. 82, 1855.

ophthalmoscope, and the choroid lining the staphyloma was found atrophied and destroyed, the sclerotic itself being attenuated at this spot; but it remained for future observers to throw additional light on the cause of these changes.

Causes of the elongation.

Dr. Giraud-Teulon appears to have done much towards unravelling the mystery. We may assert generally that among myopics, accommodation and convergence of the optic axes are called into play to a greater extent than in emmetropics; the latter action is especially augmented. In its normal condition the globe of the eye is kept in a state of equilibrium, and its spherical form maintained by the recti and obliqui muscles. When the eye is turned in any direction, the opposing muscle relaxes in exactly the same proportion as the other set of muscles contracts, and in this way injurious pressure on the globe is prevented.

Muscular pressure during convergence.

To take the case of simple convergence: if the action of the internal rectus were unopposed, the eye would be drawn inwards, but the action of the external rectus and superior oblique causes it to turn on its axis, producing abduction of the cornea. At the same time the insertion of the obliqui is carried from behind outward and forward, and those muscles compelled to describe a larger circle round the globe: hence in proportion to the degree of convergence, the globe, by reason of its shape, tends to stretch the obliqui; an action that must manifestly be attended by an equal reaction on their part, increasing internal pressure. The simple physiological movement of convergence in a horizontal plane necessarily produces a tendency to increased intra-ocular tension.†

Aggravated in myopics by habitual near sight.

Evidently, therefore, myopics are subject to increased intra-ocular pressure, in consequence of the excessive convergence they are obliged to use in order that they may see clearly; and in consequence of this increased tension, venous congestion of the choroid is established, and so softening and extension of the tunics of the eyeball at the point of least resistance. The choroid being stretched at this point undergoes consecutive atrophy, and in many instances inflammatory action is set up, producing choroido-retinitis, and complications involving the vitreous.

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* *Ophthalmic Hospital Reports*, vol. v. p. 383.

Cases of posterior staphyloma may be divided into two classes; the first, in which the disease is stationary, and the second, in which it is advancing.

Two classes of cases.

1. *Stationary Form.*—In this form, the patient suffers from myopia, which may not have been noticed until he reached the age of twelve or fifteen years. I have seen several cases in which the defective vision was first discovered upon a boy's attempting to decipher words or figures on a blackboard at a distance of thirty or forty feet; his fellow students could probably readily make them out, but they appeared hazy and ill-defined to him, unless he went up to within a few yards of the board. Under these circumstances, on examining the eye, we discover that it generally appears to be more prominent than is natural, in consequence of its being elongated from before backwards. The posterior segment of the eye when inverted is perhaps of a slightly bluish colour; and the patient complains of a feeling of fulness and pain in the eye after long-continued work.

1. Stationary.

Myopia; overlooked in children.

With the ophthalmoscope, in a well-marked instance of this kind, we shall be struck by the appearance of the optic disc, which at first sight seems to be distorted in shape and altered in size, in consequence of the formation of a crescent of a brilliant white colour, which has formed at the outer side of the disc. This crescent is due to thinning and atrophy of the choroid over the part affected, so that the glistening sclerotic shines through it, producing the appearance above described. The small retinal vessels can be traced over the white background formed by the sclerotic. The outer border of the crescent is well defined by a rim of black pigment, beyond which, again, the fundus of the eye appears healthy. In these cases the choroid and sclerotic project backwards at this crescentic spot, forming a posterior staphyloma. (Fig. 3, Plate VII.) If Professor Von Graefe's test, of the existence of binocular vision by means of a prism (chap. xiv.) be employed in these cases, we shall find that an insufficiency of the internal rectus exists.

Choroid wasted around papilla.

Black border.

Sclerotic projects backwards.

Treatment.—The abnormal condition above described may remain stationary for years, and in fact for life; but, on the other hand, active changes may at any

Treatment.

While stationary. time be set up, and we should explain this fact to our patient, informing him that if the eye begins to trouble him, if he gets an aching pain over the brow after exerting it, or if the glare of the sun is felt to be particularly dazzling and uncomfortable, the sight becoming somewhat hazy—that these symptoms indicate advancing mischief, and should be at once attended to. Supposing, however, no such complications occur, we may content ourselves with simply ordering a pair of concave glasses to correct the myopia, and that in reading and writing he has the advantage of a good light, and is not allowed to stoop over the object he is working at. It will be well also to order him a pair of blue-tinted glasses, which he should wear when exposed to the glare of the sun.

Concave glasses.

Rest and protection.

2. Progressive form.

2. *Progressive Form.*—The symptoms which characterize progressive posterior staphyloma are as follows:—We may notice the same deficiency of the internal rectus, and the patient suffers from myopia, but he usually consults us on account of general impairment of vision, which increases after over-exerting his eyes. At such times he complains of an aching pain in the orbit, extending to the temple, and also of more or less intolerance of light; the glare of the sun is trying, and induces not only an uncomfortable aching feeling in the eye, but even photophobia. He may have suffered from repeated attacks of this kind, lasting for a month or six weeks, and then passing off, reappearing, however, after unusual exertion of the eyes, or derangement of the general health. Each attack causes the sight to become more impaired, and the myopia increases, often rapidly.

Deficiency of internal rectus.

Myopia.

Recurring attacks of pain;

after work.

Sight fails.

If an eye affected with this disease be examined with the ophthalmoscope in its early stages, the fundus appears healthy, with the exception of a portion surrounding more or less of the disc, where, usually on the outer side, a patch of choroid will be observed of a lighter grey colour than normal, the vessels of the part being congested (Plate VII., Fig. 3). The alteration in the colour of this spot will be most marked near the disc, from thence, passing outwards, a number of small white patches are noticed in the choroid, these gradually coalesce into the glistening white crescent surrounding the outer part of the disc. Irregular spots of black pigment will be seen scattered over the ex-

Alterations round papilla.

Gradually shading off.

ternal border of the diseased patches, but the strongly marked rim of pigment, pathognomonic of stationary posterior staphyloma, is seldom seen. In fact, the difference between the two forms of disease consists in this, that in the progressive affection, owing to the active changes which are going on in the part, the line of demarcation between the diseased and sound tissue is broken through, and the degenerative process is extending outwards, or more probably in every direction.

No defined border.

The process appears to be essentially one of a degenerative nature, the stroma of the choroid, and the corresponding portions of the sclerotic become inflamed and degenerate; and as the latter loses its power of resisting the intra-ocular pressure, a posterior staphyloma results. This condition having once commenced, the protrusion increases in dimensions, until it often becomes of considerable size.

Process degenerative.

This accident, however, is by no means the only ill-effect likely to follow progressive posterior staphyloma; opacity, and fluidity of the vitreous, and detachment of the retina are unfortunately too frequently the direct result of this form of disease. The former affection will be recognised at once; on examining the eye with the ophthalmoscope, a number of black, flocculent-looking shreds will be noticed floating in the vitreous, and will be best observed by the direct method of examination; they are to be seen whisking about in all directions upon the slightest movement of the eye, causing the patient the greatest annoyance. The state of the choroid may often be observed, even at this stage of the disease, through the fluid vitreous, and the history of the case will indicate the nature of the disease; we may also examine the eye least affected, and the chances are that a posterior staphyloma will be detected in it, and thus we may be able to form a safe conjecture as to the cause of the fluid vitreous in the diseased eye.

Often followed by fluid vitreous

During the progress of this affection, detachment of the retina is likely to take place; for, as the staphyloma projects backwards, one of two things must occur: either the retina will be stretched and torn across in following the sinuosities of the choroid; or else, bulging backwards into the staphyloma, it will be dragged away from its attachments, either at the optic

and detached retina.

foramen or ora serrata. If the dioptric media are sufficiently transparent, we may watch these changes with the ophthalmoscope; frequently, however, the vitreous becomes so hazy that the retina cannot be seen, though we may be pretty well assured of its disorganized condition, by the almost complete loss of vision from which the patient suffers. And, lastly, secondary glaucoma may supervene at any stage of the disease, either in the inflammatory form or as glaucoma simplex, and unless an iridectomy is performed will end in blindness; for, as a rule, both eyes are sooner or later affected in this way. In cases of this description we shall have symptoms of glaucoma supervening on those of advancing myopia, or sclerochoroiditis posterior.

Treatment.

Endeavour to arrest the disease.

Treatment.—It is absolutely necessary, therefore, that we should do all in our power to stop the progress of the staphyloma, and the degenerative changes going on in the choroid in its early stages, in order to prevent the occurrence of these unfortunate terminations. I have already described its leading symptoms and ophthalmoscopic appearances; if, therefore, we meet with a case presenting these features, and learn that there has been any recent aggravation of the symptoms, we should make careful inquiries regarding the patient's employment, habits, and general state of health, with the view of correcting whatever may be wrong. Overwork is almost always the exciting cause of these changes; under any circumstances we must enforce absolute rest of the eye. The cold douche may often be used with advantage, morning and evening.

Promote the general health.

Enforce rest.

In addition to these general measures, if active changes are going on in the eye, apply two leeches to the temple for three consecutive nights, fomenting the part well afterwards. The patient should be kept in a dark room until all symptoms of pain and intolerance of light have passed away; he may then be permitted to take exercise in the open air, wearing a pair of blue glasses when exposed to the glare of the sun or lamp-light; but he must not be allowed to resume his work until the congestion of the choroid has disappeared. Small doses of bichloride of mercury, continued for some time, are useful if inflammatory changes are advancing in the choroid.

Purgatives, leeches, low diet, in active stages.

Issues.

In many instances, however, attention to the state of the general health, together with the cold douche and rest, will be the chief curative means at our disposal. An issue may be opened in the skin of the temple. By a judicious plan of treatment of this kind, the symptoms indicating active changes in the choroid will gradually subside, and the patient may then be allowed to use his eyes, though he cannot be too careful not to overwork them.

Treatment hopeful.

If these precautions are strictly observed, we may with confidence hope to preserve our patient's sight; taking care, whenever the uneasiness or pain in the eyes returns, to have recourse to a system similar to that above described, so as to prevent the destructive changes from making further progress. But I need hardly remark, that when degenerative changes have taken place in the choroid, retina, or vitreous, our prognosis must be very guarded; we can only expect to preserve the amount of vision that exists, and not to restore that which is lost.

Concave glasses essential.

Lastly, it is above all things necessary to supply the patient with proper concave glasses, so as to correct the defective refracting power, and thus prevent the increased convergence of the eyes which myopia renders necessary. As a means to this end, the patient must not attempt to read when in the recumbent position, or to write with his head bent close down over the paper.

Tenotomy of external rectus.

But more than this may be required. It has been demonstrated by Dr. Giraud-Teulon that this progressive myopia is due to an insufficiency of the internal rectus, and both he and Professor Von Graefe therefore recommend tenotomy of the external rectus in cases of extreme progressive posterior staphyloma. The former learned doctor lately observing that he had then a case of extreme myopia under his care, in which intermittent strabismus had commenced, and where tenotomy of the external rectus suddenly diminished the myopia by $\frac{1}{13}$, or from $\frac{1}{5}$ to $\frac{1}{8}$. Dr. Derby has published an interesting series of cases, in which the curative effect of dividing the internal rectus in cases of advancing myopia, is well demonstrated.* In three instances of this kind under my own care, this operation has been followed by marked, and up to the present time favourable results.

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* "Progressive Myopia and its Operative Cure," by R. H. Derby, Ophthalmic Surgeon to the Demilt Dispensary.

TUBERCLE IN THE CHOROID.

TUBERCULAR MATTER IN THE CHOROID.—The formation of tubercular matter in the choroid has been noticed amongst persons suffering from phthisis. If in a case of this description the patient's eye be examined with the ophthalmoscope, circumscribed rose-coloured spots may be seen, usually situated near the optic disc; and as the tubercular matter increases it forms nodules, pushing the pigment-cells of the choroid on one side; their outline is consequently marked by a border of black pigment, and their raised and uneven surface can hardly be mistaken for any other condition of the parts. As the disease advances, the functions of the choroid become impaired, and the vitreous passes into an opaque condition, rendering all further changes in the structures posterior to it very indistinct. It does not appear that the tubercular masses themselves excite irritation in the choroid, nor do they induce any pain in the eye.*

Raised patches with dark borders.

No pain.

Sight impaired by hazy vitreous.

If impairment of vision exists in these cases, it is probably due to disease of the choroidal vessels. The coats of the vessels being infiltrated with earthy matter, which greatly interferes with the nutrition of the tissues, hence arise atony of the ciliary muscle, and a hazy state of the vitreous. No doubt if the tubercular matter were formed directly in the axis of vision, it might, by displacing the retina, destroy its functions to a great extent; but cases of the kind are extremely rare.

WOUND OF CHOROID.

WOUNDS AND INJURIES OF THE CHOROID.—It is evident from the protection the choroid receives from the parts around it, that it cannot be wounded unless the sclerotic or other external structures of the eye are injured. In incised wounds through the sclerotic, hernia of the choroid seldom occurs, in consequence of the intimate connexion which exists between these structures; in fact, the wound of the choroid is generally a very small

Hernia cannot occur.

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* Carter's translation of Zander on the Ophthalmoscope, p. 169.

matter compared with the lesion likely to be inflicted on the retina and other structures contained within the eyeball.

Retina may suffer.

Blows or similar injuries inflicted on various parts of the eye are by no means unfrequently followed by a rupture of some of its bloodvessels. If the effusion of blood is considerable, it bursts through the retina, and infiltrates the vitreous body, probably finding its way into the anterior chamber. Cicatrices of wounds in the choroid, following contusion of the eyeball, have been noticed during life by means of the ophthalmoscope.* In less severe injuries a small clot of blood may form in the choroid, where it may be seen with the ophthalmoscope, the retinal vessels crossing over it.

Sight lost for the time.

In more severe cases, the patient will completely lose the sight of the injured eye from the instant the accident has occurred, though he may suffer from little or no pain in it. On examining the eye, we shall find, very probably, that the anterior chamber is full of blood; or it may happen that the hæmorrhage has not reached so far forwards, but that on dilating the pupil and examining the eye with the ophthalmoscope, we find the vitreous opaque, and infiltrated with blood. But in the less severe cases, where the hæmorrhage is limited, the patient may only complain of haziness of vision, depending upon a displacement of the retina forwards by a clot of blood in the choroid.

Blood in the anterior chamber

or vitreous.

Prognosis must be guarded.

Prognosis.—This will vary according to the apparent nature of the lesion. I say apparent, because if the hæmorrhage has been considerable, it is impossible to ascertain the extent of the damage done to the eye until the blood has become absorbed; but it rarely happens that extensive hæmorrhage of this kind takes place within the eye without breaking down the attachments of the retina, or otherwise damaging the eye as an organ of vision.

Retina often detached.

In the less severe cases, the clot of blood may be absorbed in the course of a few days, and the functions of the eye will be perfectly restored.

Hæmorrhage from the choroidal vessels is evidently far more apt to follow an accident if the part is diseased. We meet with instances of the kind among persons suffering from myopia, consequent on extensive posterior staphyloma. The imperfection of vision from which such patients suffer is a cause of their being more liable to blows on the eye than other persons; for they are less able to guard it, and, at the same time, the globe is often prominent. Moreover, the diseased state of the choroid renders its vessels likely to be ruptured by a blow on the eye. I have met with several instances of this kind, where the accident has been followed by hæmorrhage into the vitreous; and it has been subsequently discovered that extensive detachment of the retina had occurred. Even where the retina escapes, the blood in these cases, oozing into the choroid, may damage its structure to such an extent that it subsequently atrophies; and this is quickly followed by opacity of the lens and vitreous.

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* See cases reported by Dr. P. Frank, *Ophthalmic Hospital Reports*, vol. iii. p. 84.

Liability of myopics.

Unfavourable termination.

Treatment. Cold to eye.

Treatment.—If the accident has only recently occurred, it will be advisable to apply ice to the eye, and keep the organ at perfect rest, so as, if possible, to stop any further hæmorrhage. But if the accident has taken place some time before we see the patient, we may simply keep the eye at rest with a pad and bandage until the effused blood has become absorbed.

Rest.

Hæmorrhage into choroid may result from disease.

We occasionally meet with cases of hæmorrhage into the choroid resulting from an engorged state of its vessels, as in glaucoma, or after over-exertion of the eye. The effused blood presents a uniform dark crimson appearance, varying in shape and size, the hæmorrhage being on a plane posterior to the retina. The retinal vessels passing over the clot can be clearly recognised with the ophthalmoscope. The extent and situation of a clot of blood will, under these circumstances, lead us to form a prognosis; small spots of hæmorrhage, if near the ora serrata, may become absorbed and leave the eye uninjured, and this may be the case even with large effusions in the axis of vision, but scotoma more commonly result; and the hæmorrhage depending on some local disease is apt to return.

DETACHMENT OF CHOROID.

DETACHMENT OF THE CHOROID from the sclerotic may occur as the result of an injury or from disease, as for instance, the growth of a tumour in the choroid.* With the ophthalmoscope, we may observe the rent made in the choroid, and through it the white and glistening sclerotic can be seen. In these cases the retina is of course detached with the choroid, and the sight of the eye is therefore irrevocably lost at the seat of injury.

Loss of sight.

Partial detachment.

In some rare cases the choroid is only partially detached from the sclerotic, by a collection of blood or serous effusion forcing its way immediately within the sclerotic, tearing the choroid from its attachments and bulging it forward together with the retina into the vitreous chamber: the most characteristic symptom is the appearance of the choroidal vessels and intravascular spaces lying close beneath the retina.† The protuberance thus formed may be seen by transmitted light, and might be mistaken for a malignant tumour springing from the choroid; but in instances such as I am describing, the history of the case and the absence of increased tension of the eyeball, or other symptoms indicative of malignant disease, will lead to a correct diagnosis.

SYMPATHETIC CHOROIDITIS.

SYMPATHETIC IRRITATION OF THE CHOROID.—I have already described (p. 347) the symptoms of irido-choroiditis, which, as I then remarked, is by no means uncommonly induced by wounds or injuries involving the ciliary body or the choroid. The phenomena of sympathetic irritation of the choroid are those of irido-choroiditis.

Symptoms as in irido-choroiditis.

TUMOURS OF THE CHOROID.

SARCOMA: its characteristics.

SARCOMA OF THE CHOROID, like similar abnormal growths in other parts of the body, is characterized by a preponderance of cellular elements, of a stellate, spindle-shaped, or roundish form, resembling those of connective-tissue cells, and containing numerous nuclei. These cells differ, however, very materially from those of connective tissue, in that they are incapable of passing into the stage of perfect connective tissue. They are prone, however, to combine with intercellular substances, and thus form a relatively firm vascular and coherent structure. In these respects sarcoma presents a different growth from epithelial formations, and also from cancer. In sarcoma we often find the cellular elements not only preponderating, but containing a quantity of dark pigment assuming the medullary or melanotic form. This is especially the case when the disease springs from a structure already containing much pigment, as is the case with the choroid.

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* *Ophthalmic Review*, vol. i. p. 79.

† A Treatise on the Diseases of the Eye, by Soelberg Wells. Third Edition, page 511.

Cells often contain pigment.

Symptoms.

Symptoms.—Sarcoma of the choroid commences as a slight elevation or patch in the choroid, which may be seen with the ophthalmoscope; the base extends, and at the same time the tumour advances forwards upon the retina, inducing changes in its delicate structure, so as to render its nervous matter opaque. At the same time a collection of fluid takes place between the advancing sarcoma and the opaque retina, the latter therefore forming an undulating projection vibrating with every movement of the eye, and clearly recognisable in the vitreous chamber by aid of the ophthalmoscope.

As a general rule, the disease does not take long to grow, but may be interrupted by periods of inactivity. As the sarcoma increases, involving more of the choroid, the lens and vitreous become opaque, preventing our watching its subsequent growth within the eye. During the early stages of the disease irido-choroiditis most frequently complicates the other symptoms, and at a later period the cornea becomes hazy and ultimately opaque. The intra-ocular tension is much increased, and the patient usually suffers intensely from pain in the eye and over the corresponding side of the head.

Advanced stage of disease.

As the disease advances, staphylomatous bulging may appear in the ciliary region, from degeneration of the sclerotic. The cornea or sclerotic is perforated, and the tumour protrudes through the opening, presenting the appearance of sarcoma as seen in other parts of the body. It sometimes happens, however, that while still intra-ocular, the sarcoma degenerates into a fatty mass and becomes atrophied, the eyeball at the same time shrinking up to a small button over the remains of the morbid growth, which we have too much reason to fear will, sooner or later,

May atrophy.

again put forth its latent energies and grow with increased rapidity. In some few instances sarcoma of the choroid has been known to invade the sheath of the optic nerve, and growing backwards has filled the apex of the orbit so as to thrust the eye outwards, protruding it from between the eyelids, before the nature of the tumour behind could be exactly ascertained.

May invade sheath of optic nerve.

Carcinoma differs in its anatomical relations from sarcoma in that it consists of a meshwork or stroma, the interspaces being filled in by groups of cells, often of a spindle-shape, with fine processes as their poles. The alveolar spaces formed in the stroma of carcinoma are readily seen on a section of the tumour, and slight pressure applied to the specimen is sufficient to squeeze out the cellular elements from the meshwork in which they are contained. These cells often include a large quantity of pigment matter.

Carcinoma: its characters.

Carcinoma is most malignant; it invades tissues with little difficulty, even those as hard as bone, and much more a fibrous structure such as the sclerotic. The lymphatic glands in the neighbourhood of a cancerous growth are soon involved, and cachexia is a prominent symptom of the disease. The patient usually suffers severely from pain in the part affected by cancer. Carcinoma of the choroid is, however, a rare form of disease, but is occasionally met with both in the medullary and melanotic forms.

Malignant.

Glands involved.

Cachexia, pain.

Treatment.—In the early stages of both sarcomatous and cancerous affections of the choroid, and before the morbid growth has invaded the orbit, we should certainly attempt to remove the disease by excising the globe of the eye. Subsequently, when the tumour has burst through the sclerotic and involved the parts around, we are not justified in attempting to remove it with the knife.* We may diminish the patient's suffering by means of anodynes, and the vapour of chloroform applied to the surface of the growth; but beyond attempting to relieve pain, little can be done.

In first stage remove the eyeball.

Later, relieve pain.

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* "A Practical Work on the Diseases of the the Eye," by F. Tyrrell, vol. ii. p. 165-187: Dalrymple, "Pathology of the Eye," Pl. XXXIII. (letter press.)

CHAPTER XI.

DISEASES OF THE RETINA, ELASTIC LAMINA, AND OPTIC NERVE.

Hyperæmia of the Retina—Retinitis—Hæmorrhage—Nephritic Retinitis—Retinitis pigmentosa—Retinitis Apoplectica—Detachment—Embolia—Ischæmia—Atrophy—Glioma of the retina—Hemeralopia—Snow blindness—Colour blindness—Hemiopia—Scotoma—Diseases of the elastic lamina—Hyperæmia of the optic nerve—Apoplexy—Optic neuritis—Atrophy of the papilla—Amblyopia—Amaurosis.

HYPERÆMIA AND INFLAMMATION.

HYPERÆMIA OF RETINA: transient.

HYPERÆMIA OF THE RETINA may be a transient affection, depending simply on over-exertion of the eye, or upon a deranged state of the stomach. Under these circumstances it passes away so rapidly, that it is not likely to attract the attention of either the surgeon or patient. But whatever the exciting cause of the hyperæmia, should it remain in force, inducing chronic congestion of the retina, serious results may follow.

Peristent, with œdema.

We shall almost invariably find the retina more or less œdematous in cases of hyperæmia (Plate V., Fig. 1), unless the congestion be of a very transitory nature: and if congestion of the vessels and œdema co-exist, we may be sure that the bounds of health have been passed, and that disease has commenced.* In such cases, although the congestion and its consequences may entirely disappear, leaving the parts in a normal state, still it is always necessary to be on our guard, remembering that the effusion, though harmless in itself, has taken place in a most fragile and delicate tissue, which may readily be injured or detached from the choroid.

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* The form of disease under consideration is described by some authors as serous retinitis.

Ophthalmoscopic Appearances.—I have already explained why the healthy retina of the native of India appears of a uniformly bright slate colour when examined with artificial light (p. 35), except where the central artery and vein meander through it. Consequently, if in the case of a native, the retina appear of a crimson hue, however slight the tinge may be, we may be certain that there is something wrong, although the changes which have occurred in it may not amount to actual disease. For instance, if the pupil has been dilated with atropine, and the patient subsequently exposed to the glare of the sun, the excitation thus induced will cause temporary hyperæmia and redness of the retina.

Grey fundus of native's eye.

A crimson tinge morbid;

denotes hyperæmia.

I may take this occasion to observe, that it is advisable to delay putting atropine into a patient's eye, until just before making an ophthalmoscopic inspection; and we should never, after applying it, turn our patient out into the sun, telling him to call again for examination the next day; for it will then be impossible to judge if any alteration in the vascular condition of the retina is due to the effects of disease, or to the excitation induced by over-exposure to light. But excluding exceptional cases, the above rule holds good, and a tinge of red observed in a native's retina indicates a departure from health.

Caution as to atropine.

What has just been said does not of course apply to the case of Europeans; nevertheless among fair-skinned races, the congested state of the vessels of the retina, in cases of hyperæmia, is generally apparent,[*] and should one eye only be affected, a comparison of its condition with that of the other will generally remove any doubts we may have had as to the nature of the disease. The retinal veins also, under these circumstances, become more or less turgid, and the vessels of the choroid, and its epithelial cells, are clouded over by the congested and œdematous retina. These changes are best seen if only a dim light is thrown into the eye.

Retinal hyperæmia in European.

Compare the two eyes.

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[*] "Maladies des Yeux," par L. A. Desmarres, t. iii. p. 452.

Causes.

Blood poisoning.

Overwork an exciting cause.

Causes.—Hyperæmia may arise under various circumstances, but in almost all cases there is some peculiar blood dyscrasia, which is the latent cause of the mischief. This may be roused into activity by various exciting causes, as for example, overwork; and we consequently find that instances of the kind are common among embroiderers and tailors in Calcutta. These people frequently sit up at night working by the light of an oil-lamp, the flame of which is hardly equal in brilliancy to that of a farthing rushlight; their general health being at the same time impaired by malaria, want of fresh air, and low living.

How acting

The train of morbid phenomena commences with the demand for extra nutrient material, caused by the waste induced by the overwork to which the retina is exposed; and though we cannot appreciate the changes that are going on in its nervous elements, we may judge accurately of their activity by the congested appearance of the vessels. If the exciting cause of the hyperæmia continue, one of two results follows,—either the retina becomes atrophied, and the supply of blood being no longer required, the hyperæmia gradually ceases, or else, the congestion continuing, neo-plastic structures are produced, which intermingle with the delicate nervous elements of the retina, and destroy its sensibility.

May end in atrophy.

Mechanical hyperæmia.

Another source of retinal hyperæmia is mechanical obstruction, induced by pressure upon the orbital vessels; but I shall treat of this form of disease more fully hereafter, as well as of congestion of the retina induced by overstraining the eye, as observed in the case of hypermetropic and myopic patients.

Hyperæmia from malaria.

A more frequent and important cause of this condition is to be found in the influence of malaria. This may operate immediately through the blood, producing changes in its composition, which render it unfit for the nourishment of the tissues, delaying its progress through the capillaries, and so giving rise to local congestions; or else we must suppose that the poison, after entering the circulation, acts directly on the sympathetic nerve, and so on the vascular system. We know that division of the sympathetic in the neck induces hyperæmia of the retina, and other parts which the injured nerve supplies. We may readily suppose that it is by some such paralysing influence which the malarial poison exercises over the sympathetic, that local congestions, such as we are now considering, are produced. However this may be, there can be no doubt of the fact that we frequently do meet with cases of hyperæmia of the retina among persons who have imbibed a large dose of miasmatic poison.

Influence of sympathetic nerves.

We often have cases under treatment, both among Europeans and natives, which illustrate the effects of these combined influences in inducing capillary congestion of the retina, and the more carefully one studies these cases, the plainer it becomes that the capillary circulation is chiefly affected. In many instances, the overwork which the retina is called on to perform probably induces an increased demand for reparative material, the starting-point of the hyperæmia. The congestion continuing, the bounds of health are passed, the transition being marked by effusion into the retina, and an opaque condition of its nervous elements. This is a most important point to bear in mind; for when these conditions are present disease has commenced, and will surely progress to an unfavourable termination, unless stayed by appropriate treatment.

Capillary congestion.

Œdema and opacity of retina.

Pain is by no means a characteristic symptom of hyperæmia of the retina; the disease often runs its course from beginning to end, the patient only complaining from time to time of slight aching pain in the eye; in fact, gradually increasing loss of sight is the only constant symptom present, and its cause, as far as I know, can alone be determined by means of the ophthalmoscope; the outer part of the field of vision is usually first compromised, but ultimately the macula lutea loses its sensibility.

Loss of sight constant.

I have selected the following instance from those which have recently been in hospital as an illustration of the malarial form of nervous effusion and hyperæmia into the retina.

Retinal hyperæmia from malaria only.

Case.—Comol, aged thirty-five. This patient has been suffering from intermittent fever for the last three weeks; the paroxysms recurring daily at about eleven o'clock. During the last five days she has had, in addition, considerable pain in the right side of the head (hemicrania), and the sight of the right eye, which had previously been good, has become very dim. She is stout, and with the exception of these attacks

Case. Intermittent fever.

Dim vision.

of fever, apparently healthy. On examination, there were no indications of her liver or spleen having been affected, nor could I discover evidence of hyperæmia existing in any of the organs of the body, excepting the retina. In the right eye, I found the tension normal, and the dioptric media healthy, the pupil contracted, and only dilating after long exclusion from light. The retina, including the optic disc, was of a rose colour, and the swollen and slightly hazy appearance of the retina induced by œdema, was well marked. The sight of this eye was considerably impaired; she could just see to count fingers held up before her face.

Capillary hyperæmia of retina.

Treatment.

I ordered her an emetic, followed by a full dose of opium, and the eye was carefully bandaged, so as to exclude the light from it; on the following day arsenic and opium were prescribed. After a week's treatment the pain in the head subsided; there was no return of the fever, and in the course of fourteen days the hyperæmia of the retina had disappeared, and the patient's vision was as good as it had ever been.

Arsenic and opium.

Œdema always present.

Even in mild cases of hyperæmia, we shall invariably find that some amount of serous effusion has taken place into the retina, which causes it to appear soft and swollen; but unless it becomes decidedly opaque, the effused serum may be rapidly absorbed, and the parts return to their normal condition.

Importance of these changes.

It may perhaps appear that I have dwelt too long upon this subject; my reasons for doing so are, that hyperæmia is of common occurrence, and is likely to be overlooked. Moreover, elementary and apparently unimportant changes in the retina, and other tissues of the body, are those which it behoves us to study most minutely, for here is the point of departure for more serious disease, and here we may most successfully oppose it. A case of retinitis, like that of inflammation of the lungs or liver, must unavoidably attract the notice of the most superficial observer, whereas local congestions such as I have been describing are very apt to escape our notice. But I am by no means sure, that instances of this description which I have here given and treated over and over again for the last fifteen years in Bengal, are not many of them cases such as Dr. Clifford Allbutt in his admirable work on the ophthalmoscope, in diseases of the nervous system, designates as "Ischæmia of the disc." To my mind it is quite certain that numerous cases described by various authors as instances of optic neuritis, have had nothing whatever to do with inflammation of the optic nerve. There is much in a name, and in no department of art, have worse effects followed a faulty nomenclature, than in medicine and surgery.

Treatment.

Treatment.—It only remains for me to say a few words on the treatment of hyperæmia of the retina.

Look to the cause.

Correct the dyscrasia.

The disease may generally be prevented from running on to the destruction of the eye, if observed in its early stages; but in order to succeed in arresting it, we must endeavour to form an accurate opinion of the constitutional dyscrasia which is usually the primary cause of the affection, and apply our remedies accordingly. The next point we should bear in mind is, that as light is a certain and constant stimulant of the retina, it must be excluded from the eye when in a state of irritation. If the patient be suffering from the effects of malaria, tonics and arsenic should be administered; occasional doses of quinine may be useful, if there is actual ague; or an emetic, followed by a full dose of opium at bedtime, and a mixture containing arsenic and aconite.

Tonics.

Arsenic.

Change of air.

There is no question as to the great importance of overcoming the hyperæmia of the retina as soon as possible; and the above remedies, according to my experience, together with change of air, if practicable, will be found the most valuable means we possess for this purpose. The arsenic, however, should be continued for some time after the actual disease has disappeared; for the malarial poison sometimes works in so insidious a manner, that it is impossible to detect its presence in the system. Nevertheless, its influence is hardly less detrimental than when present in its more developed form.

INFLAMMATION OF RETINA.

PARENCHYMATOUS RETINITIS occurs among people of all ages and classes; it may arise from the effects of an injury, or from idiopathic causes. If the retina be primarily affected, the inflammatory action may be confined to that part; but as a general rule, in severe cases, the choroid becomes also implicated in the disease; both eyes are often involved.*

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* "Lectures on the Theory and Practice of the Ophthalmoscope." By H. Wilson, F.R.C.S. Dublin, 1868.

Pain and photophobia.

Symptoms.—Retinitis generally commences with a throbbing, aching pain in the eyeball and temple;* after a few days the pain increases, and is often very severe indeed; the patient also suffers from intolerance of light and the appearance of flashes of light in the field of vision, and from lachrymation. From the commencement of the attack he complains of more or less dimness of vision; the loss of sight, however, depends much upon the portion of the retina involved: if the inflammation be confined to its periphery, there will be less impairment of vision than if the region of the yellow spot is implicated. The tension of the eyeball is generally slightly increased. The dioptric media remain transparent throughout the early stages of uncomplicated retinitis; but in chronic cases, or when the choroid is affected, the lens and vitreous become hazy. The vessels of the sclerotic and conjunctiva are usually congested, especially in traumatic retinitis.

Flashes of light.

Dim vision.

Slight increase of tension.

I need hardly say, that the above symptoms are insufficient for the purpose of diagnosis, and we must have recourse to the ophthalmoscope; but it will sometimes require dexterity on our part to obtain a satisfactory view of the inflamed retina, on account of the inability of the patient to bear the light.

Fundus, hard to see.

In acute parenchymatous retinitis the fundus of the eye, including the optic disc, is of an uniform scarlet colour, unless hæmorrhage or neoplastic formations have formed in its structure. The vessels of the papilla are deeply congested—so much so that the disc cannot be distinguished from the retina; its position can only be determined by the point of entrance and exit of the large vessels. The central artery of the retina is usually of normal calibre, but the veins are sometimes remarkably tortuous, and very much congested; they may appear to coil round, so that at one turn of the spiral it seems to be larger than at another. (Plate V. Fig. 3.) A venous pulse may generally be observed in these enlarged vessels. In most cases extravasations of blood of various shapes and sizes are seen scattered over the retina. The retina itself is hazy, swollen, and œdematous; and if carefully examined, faint whitish streaks may be seen radiating in

Uniformly scarlet.

Disc not distinguished.

Veins much congested.

Retina swollen.

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* "Maladies des Yeux," par L. A. Desmarres, t. iii. p. 449.

all directions from the situation of the optic disc towards the ora serrata. These are formed by the nervous layers of the retina becoming puckered, in consequence of the effusion which tends to drag it from its attachments; in the same way as a cushion, inflated with air, becomes wrinkled from the point at which pressure is made upon it with the finger. These markings upon the retina are, however, very faint, and it is not essential to see them for the purpose of diagnosis, as the disease may be at once identified by the general appearance of the fundus of the eye. Patches of neo-plastic formation of various sizes, sometimes only small greyish-white dots, at other times larger spots, are frequently to be seen in the congested retina. If the inflammatory action is severe, the choroid becomes involved in most cases; but as the epithelium of the elastic lamina is entirely concealed by the inflamed retina, the fundus of the native's eye appears of precisely the same colour as the European's, when affected with retinitis.

White creasings.

Native and European eyes alike.

Prognosis and Results.—This disease may terminate in resolution, or the inflammatory action may become chronic; but even then the retina may again assume a healthy appearance, provided that neither in the acute nor chronic form of the disease permanent damage has been done to its structure.

Terminations.

Among the accidents which may thus interfere with a favourable termination, hæmorrhage is the most common. Extravasation of blood may occur at any stage of the disease, and though the blood may become absorbed, still the delicate nervous tissue is generally more or less damaged. Detachment of the retina may be the direct result of retinitis, or the coats of the retinal blood-vessels may become thickened, so that the stream of blood passing through them is much diminished, and they appear like whitish bands with a central red streak of blood; the supply of nutrient material to the nervous structure being thus greatly reduced, the retina is apt to become atrophied, or undergo other degenerative changes.

Hæmorrhage.

Sclerosis of vessels.

Neo-plastic formations are common in retinitis, and if they become organized, the functions of the retina are, of course, destroyed in the situation of the newly-formed tissue, a scotoma or dark spot in the field of vision remaining, although the inflammatory action

Neo-plastic formations.

subsides, and the other portions of the retina return to their normal condition. Lastly, suppuration may occur as a consequence of inflammation. The only cases, however, in which I have seen this accident happen, have been those in which the retina has been kept in a state of irritation by a foreign body, such as a dislocated lens moving about over its surface, or in traumatic cases.

Suppuration.

If, after acute retinitis, resolution should fortunately occur before irreparable damage has been done to the retina, we notice that the appearances above described gradually disappear, the redness of the fundus of the eye subsides, and the vessels return to their normal calibre; the pain and intolerance of light grow less, and ultimately the patient regains his vision, which may in time become almost as perfect as it was before the attack. So favourable a result as this, however, is seldom met with in practice, the more so, if the region of the yellow spot has been involved in the inflammatory action, and neo-plastic formations have grown in this situation. In some rare cases after an attack of retinitis, all objects appear smaller to the patient than they actually are. This condition is called micropsia, and is due to the rods and cones of the retina having become deranged by means of the inflammatory process. Under these circumstances, a person if attempting to copy figures will always make them smaller than they really are. A man affected in this way is quite unfit for military service, and I have had more than once to invalid men suffering from micropsia, following an attack of parenchymatous retinitis.

Recovery.

Treatment.

Treatment.—Since, with the exception of traumatic cases, retinitis almost always depends upon constitutional dyscrasia, induced by malaria, or some such poisonous influence acting on the blood, our efforts must be primarily directed towards eradicating these deleterious agents from the system, and we shall then have to decide on the special line of treatment which may be most appropriate in the case before us.

Attack the dyscrasia.

If our patient is a weakly subject, who has suffered from frequent attacks of fever, we should order both eyes to be kept carefully closed with light pads of cotton wool, the patient being allowed to take exercise morning and evening. If he is suffering from great pain in the eye, it will be most effectually relieved by the injection

Rest.

of a solution of morphia beneath the skin of the temple. A *bhang** poultice often tends to ease the pain, and poppy-head fomentations are frequently most soothing.

Morphia.

Should the eyeball feel at all tense, the cornea may be punctured and the aqueous humour drawn off. We need never hesitate to pursue this plan of treatment if there be any intra-ocular pressure, and I have never seen any harm arise from it, provided care be taken to prevent the aqueous from escaping in a gush. If this occurs, the congested retinal vessels will be in danger of giving way, and extensive hæmorrhage may take place into the vitreous chamber.

Draw off aqueous.

If the patient's tongue is coated, and he complains of want of appetite, it will be well to order him a few doses of hyd. c. creta, with quinine and soda. A warm bath at bedtime will tend to relieve any febrile symptoms, if they should happen to exist. It is often necessary to administer bark and ammonia, together with alteratives, from the commencement of the attack, and the patient should be allowed a generous diet, and every available means be taken to improve his general health. I do not think blisters are of much use in this class of cases.

Alteratives.
Warm baths.
Stimulants.

Supposing our patient be a full-blooded individual, and that his pulse indicates a general irritation, a saline purgative should be given, and three leeches applied to his temple in the morning, and the same number in the evening, fomenting the parts well after each application. The purgative will probably require to be repeated in forty-eight hours, and bicarbonate of potash and iodide of potassium should be administered in ten-grain doses three times a day, low diet being at the same time enforced. If the symptoms do not abate under this treatment, we may apply more leeches; together with the subcutaneous injection of morphia, poppy-head fomentations, and absolute rest of body and mind.

Lowering remedies.
Purgatives.
Leeches.
Low diet.

SYPHILITIC RETINITIS.—The presence of this form of inflammation of the retina is determined more from the previous history of the case than from characteristic symptoms; it is not in fact recognisable so much from peculiar appearances presented by the retina as from

SYPHILITIC RETINITIS.

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* Indian hemp.

Complications; Choroidal; Vitreous. Ophthalmoscopic appearances.

the evidence of constitutional syphilis; and, as we might naturally have expected, is frequently complicated by diseases of the choroid and iris. In the choroid, under these circumstances, we notice that the pigment cells become heaped into small masses, presenting, when examined by the ophthalmoscope, the appearance of greyish or dark dots and patches. At the same time, in consequence of these changes in the choroid, the vitreous undergoes degeneration; it becomes clouded, fluid, and occupied by dark flakes, thus shrouding the retina from our view, and rendering the changes going on in the optic disc and parts around somewhat obscure.

Film round vessels. Optic disc hazy. Patches in retina.

Syphilitic retinitis commences with hyperæmia of the disc and venous congestion of the retina, the arteries being diminished in calibre. The course of the retinal vessels is marked by a greyish film due to sclerosis of the connective tissue elements, particularly of the vertical trabecular fibres. This greyish film frequently appears to run along the outside of the vessels, as observed with the ophthalmoscope, forming as it were a casing of neo-plastic tissue round these vascular canals, the film being most marked along the wall of the vessel and gradually shading off into the healthy retina. The optic disc is swollen and hazy, the haziness extending beyond its circumference to a variable distance over the retina. This greyish film on the retina is seldom uniform; but as in syphilitic keratitis, so in retinitis, one part of the affected structure is usually more hazy than another. This is often particularly the case near the axis of vision, where small punctiform opacities of the retina are noticed in syphilitic inflammation of this structure: and these opaque spots undergo rapid changes often disappearing in the course of a few days.

Neo-plastic growths organized.

If the abnormal action continues unchecked, further changes in the retina become developed, for as the sclerosis advances the tissue involved becomes dense and opaque, and the nerve structure of the retina is not only destroyed, but it leads to occlusion of its blood-vessels; the neo-plastic formations become organized, a white glistening patch appearing in the place of the originally inflamed tissue. These changes may run their course in a particular spot, and yet the remainder of the retina present no abnormal appearance whatever. Perhaps the vessels passing to and from the inflamed patch may be slightly congested, but this is by no means a constant appearance; and the blood-vessels can seldom be traced beyond the inflamed spot, as the tissue in the act of becoming organized, contracts and obliterates them. So far as my experience goes, hæmorrhage is not of common occurrence in this form of disease.

Hæmorrhage not common.

Syphilitic retinitis, as I have above remarked, is in many cases preceded by iritis, and irido-choroiditis, so that we may expect to meet with evidence of pre-existing mischief in these structures; nevertheless, this is not always the case, for instances undoubtedly occur in which constitutional syphilis being present, the poison selects the retina as the first structure for attack. Under any circumstances syphilitic retinitis having commenced, the patient complains principally of impairment of vision, it may be in one or both eyes; the diminution of sight may be sudden or may creep on very slowly; it not uncommonly has periods of amendment, and then becomes worse than ever again. The field of vision presents spots of almost total blindness, other parts being comparatively normal; this is evidently dependent upon the disposition of the diseased action to affect one part of the nervous tissue of the retina at one time, and in one spot, more intensely than at another, thus altering the state of the visual field from time to time. Of course when sclerosis of any one part of the retina has been completely established, the nervous and vascular tissues being destroyed, this spot remains as a black patch in the visual field. The dimness of sight is in most instances increased, by the changes already noticed as common in the vitreous in cases of this kind.

Symptoms.

Dimness of Vision.

Visual field unequally impaired.

Prognosis.—The prognosis of this form of retinitis depends very much upon the stage of the disease when first brought under our observation. If we discover no great changes in the retina or choroid our prognosis may be favourable, even to the hope of restoring sight. But the disease being a constitutional one is apt to recur, and we must caution our patient accordingly, impressing on him the necessity of applying to us the instant he discovers any retrogression in his power of sight. When once dense opaque patches have formed in the retina I need hardly say we can entertain no hope of the corresponding portion of the retina regaining its functions.

Prognosis.

Treatment.

Treatment.—I would refer the reader to the remarks I have already made, regarding the treatment of syphilitic iritis; a long continued and carefully managed course of mercury is, I am convinced, the correct treatment for cases of this description. Like most other practitioners I have had my seasons of doubt as to the necessity for administering mercury for the relief of syphilis, and although I still believe it is impossible in all cases to *cure* syphilis, nevertheless I am equally sure we may generally destroy the manifest effect of syphilis on the tissues of the body, by means of mercury, and in few instances are the curative effects of this drug more marked than in cases of syphilitic retinitis.

INHERITED SYPHILITIC RETINITIS comes on in infancy.

Often not recognised.

INHERITED SYPHILITIC RETINITIS generally comes on in infancy, and, unfortunately, there are no external symptoms to mark the progress, or even the existence, of this formidable disease; and it is only as the child grows older that his vision is discovered to be defective.* He is then perhaps supposed to be short-sighted, or to have some affection of the eyes depending on dentition, which it is hoped he will outgrow; whereas the disease, if its real nature were recognised and judiciously treated, might very possibly be alleviated, and the sight saved. The importance of making an ophthalmoscopic examination, in the case of imperfect vision among young children, cannot be too strongly enforced. Should patches of syphilitic inflammation exist in the eye, we must at once resort to the treatment I have recommended in cases of similar affections of the iris—namely, mercurial inunction, together with tonics or alteratives, as may seem most necessary.

RETINAL HÆMORRHAGE.

From injuries.

From mechanical obstructions.

EFFUSION OF BLOOD INTO THE RETINA has been observed after injuries, through concussion, or direct wounds; or in the course of those changes which tend to impede the passage of blood through the optic disc (as glaucoma, inflammation of the optic disc, and the adjoining retina), or through the orbit, especially when the cause is situated close behind the eyeball, or at the fissura orbitalis superior. Sudden closure of the jugular veins on both sides has occasioned hæmorrhage into the retina or effusion of blood may occur in the course of changes within the eye (as tumours, retinitis, myopia), which give rise to hyperæmia of the retina and choroid, with atrophy.*

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* J. Hutchinson on "Syphilitic Diseases of the Eye and Ear," p. 130.

Extravasation of blood, as a result of retinitis, or mechanical congestion of the vessels, generally takes place in the deeper layers of the retina. The hæmorrhage is not usually very extensive, nor does it always appear to injure the nervous tissue; a patient may regain his eyesight perfectly after the inflammatory process has passed off, and the blood has become absorbed.† But as I have before observed, if the hæmorrhage, whether from inflammation or any other cause, has been extensive, and has occurred in the substance of the retina, either in or near the macula lutea, our prognosis, as to the patient's ultimate recovery, must be guarded.

Occupies the deeper layers.

If large or central, destroys sight.

It is hardly possible to mistake extravasated blood in the retina for any other condition of the parts. If examined soon after the hæmorrhage has occurred, its colour is quite characteristic. Subsequently this alters, and the hæmorrhagic effusions become darker, and are broken up into small patches. The larger extravasations gradually soften down, and are converted into a yellowish fatty substance, which may ultimately become absorbed.

Appearan of clots.

Later changes.

The depth at which the clots of blood are situated in the retina may be determined by the position they hold with regard to its vessels: the extravasation, if anterior, will of course hide the vessels; but if posterior, the central artery or some of its branches, can be traced in front of the clot. Virchow describes these spots of extravasated blood as being precisely similar to those noticed in the brain. He says:—"The corpuscles within the mass may be either completely unchanged, or partly studded with fine granules. In the interior of these red masses, as well as at their circumference, may be seen fat corpuscles and conglomerate granules, that are either collected into firmly cohering masses, or sometimes appear united into a network. The retinal

Microscopic appearances.

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* C. Bader on "Diseases of the Retina;" *Guy's Hospital Reports*, vol. xii. p. 602.

† Dr. Pagenstecher's Report of the Wiesbaden Eye Infirmary: *Ophthalmic Review*, vol. i. p. 195.

elements themselves, in this condition, appeared either wholly unchanged, or the granular layer and the ganglion cells somewhat opaque; the latter, although not enlarged, presenting a more granular and yellowish aspect than natural, over which the bacillary layer was not easily discernible. Also, the capillaries of the retinal vessels, which often form an interwoven net, showed changes both in their walls and their channels; the former, in retained permeability of the vessels, being sometimes thickly set with fat granules; the latter occluded by capillary obstructions (embolia).*

NEPHRITIC RETINITIS.

Appearances.

Causes: renal disease, malaria, and blood poisoning.

NEPHRITIC RETINITIS.—Stellwag von Carion remarks that this form of disease is characterized by collections of a cloudy substance in the posterior half of the retina, which subsequently unite to a large patch, forming a prominence around the optic papilla. This is accompanied by numerous hæmorrhagic extravasations, great local congestion, and decrease of vision. In fact, this form of retinitis is accompanied by sclerosis of the connective tissue of the retina and fatty degeneration of its nerve elements, with effusion of blood into the part; it has been described as occurring in cases of albuminuria† and disease of the kidneys. Pathological changes of the kind are not, however, confined to cases of Bright's disease; the peculiar dyscrasia induced by malaria may produce the same result, and I would warn the medical practitioner from coming to the conclusion that because he discovers evidence of retinitis albuminuria in a patient's eye, that the individual is therefore suffering from Bright's disease. Surgeons practising in the tropics very well know how often chronic albuminuria is met with, which is quite curable, and does not in any way depend on Bright's disease. I have watched instances of the so-called retinitis albuminuria for some years past, and always considered them analogous to the fatty degeneration of the muscular or secreting organs of the body, which we sometimes notice in persons exposed to malarious influences; and which may run their course either with or without the presence of albumen in the urine; sugar, in fact, often takes the place of albumen in the urine under these circumstances. We also meet with a similar morbid condition of the retina in alcoholic poisoning, the alteration being brought about, no doubt, in the same way in each case—namely, by changes in the blood and the walls of the capillaries, which render the former unfit to supply healthy nutrient material to the tissues, and the latter calculated to hinder osmosis, and to impair still further the nutrition of the parts around them, so that disease of the retina is the result.

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* Carter's *Zander*, p. 146.

† "Atlas d'Ophthalmoscopie," par Dr. Liebreich, p. 25.

Walls of vessels altered.

Degeneration of connective tissue;

Mr. Hulke states that sclerosis and fatty degeneration thus induced take place in the connective-tissue elements of the retina (glioma).* But this degenerated tissue is not the only source of the glistening white spots seen in the retina affected with this form of disease; they partly arise from the disintegration of the extravasated blood, and also from fatty changes taking place in the fibrillated coagula formed from the liquor sanguinis which is effused into the part. The larger vessels of the retina are seldom involved; it is the capillaries which are diseased, their walls being thickened by amyloid deposits. The circulation of blood is retarded through these narrowed vessels, and effusion of serum takes place into the structures around. But more than this: many of these diseased vessels give way, and small hæmorrhagic spots occur in the retina. Changes have also been noticed in the vitreous in cases of neuro-retinitis; it is apt to become hazy and granular; blood-corpuscles and small coagula from the retina have also been discovered in it.

and of extravasations of blood and serum.

Symptoms.

Symptoms.—The patient seldom if ever complains of pain in the eyes (both are commonly affected), but he notices dimness of vision, usually coming on gradually. The impairment of sight, however, progresses, though it may be much more strongly marked in one part of the field of vision than in another, and ultimately the patient may be able to recognise only the largest-sized print. In the early stages of the disease he may complain of hypermetropia; the diseased retina bulging forwards into the vitreous chamber, and therefore lying within the focal

Dimness of vision increasing.

Hypermetropia.

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* Hulke on Neuro-Retinitis: *Ophthalmic Hospital Reports*, vol. v. p. 17.

distance of the eye. (See *Hypermetropia.*) Should the disease be connected with nephritis, we shall of course find albumen in the water; symptoms of derangement of the digestive organs will be present, and in the majority of instances hypertrophy and dilatation of the left ventricle exist; but, as I have before observed, I feel convinced this so-called nephritic retinitis may run its course without evidence of kidney disease.

Albuminuria.

Ophthalmoscopic appearances.

It would be almost impossible from an ophthalmoscopic examination, to distinguish between the early stages of nephritic retinitis and the premonitory stages of other forms of inflammation of the retina. There is the same swollen œdematous and hazy optic disc; its outline is indistinct, being covered in by the bluish-grey serous infiltration. The vessels are involved in this cloud. After a time, however, the appearances change, and there is distinct evidence of great venous congestion; the cloud over the optic disc becomes denser, and extends far over the retina; in it faint whitish striæ are observable due to sclerosis of the connective tissue (Fig. 2, Plate V.). Spots of extravasated blood will be noticed over various parts of the retina and optic disc; they occur chiefly in the internal layers of the retina, and have a somewhat striated appearance; but the hæmorrhage may be more superficial, covering in a part of one or more of the retinal vessels.

Œdema.

Venous congestion.

Extravasation.

As the disease progresses, we may observe around the circumference of the swollen disc numerous white patches. These coalesce and form a ring round the papilla most marked on its inner side. This ring is separated internally by a zone of a greyish colour from the circumference of the disc, and externally it sends out processes which extend along the walls of the retinal vessels. In the region of the yellow spot small grey-white or milky points form in the retina, which rapidly increase, often uniting after a time, and becoming fused into the zone surrounding the optic disc.

White patches.

These changes may advance until the optic disc and retina become atrophied. In other cases much of the fatty matter formed in the retina may become absorbed, the patient's sight improves, and although the changes due to sclerosis do not disappear, nevertheless he regains a very fair amount of useful vision. The disease seldom leads to complete blindness.

Prognosis.

Treatment.

Treatment.—In cases of Bright's disease, it is hardly necessary to say that the retinal affection is as incurable as the principal malady, and no improvement can be looked for.

Must vary with the cause.

I have watched several cases of neuro-retinitis following malarious fevers, and have certainly seen them improve under a steady and well-regulated course of arsenic, strychnine, and iron. But above all things we must bear in mind that change of air, and in fact absolute removal from malarious influences, is necessary for the cure of miasmatic diseases. When therefore a patient comes under our notice, suffering from symptoms such as I have above described, and which we can trace to malarious influences, we certainly have it in our power to save him from irrecoverable blindness by ordering him off to sea. As far as India is concerned, no change from one part of the country to another will be of any use; all are impregnated with miasma, and hence our inability to stop the ravages of the disease I am now considering among native patients. It is useless, of course, ordering *them* to sea; and the disease will surely terminate in blindness if depending on the causes above indicated.

Removal from malarial influences.

Improved habits of life.

In instances occurring from the effects of alcohol, we must attempt to stop the use of all intoxicating fluids, and by wholesome food, tonics, and improved habits of life, endeavour to restore our patient's general health; for we know of no means more likely to improve the condition of his blood, and hence of the local disease.

Cases of Brain tumour and Bright's disease.

It is well to bear in mind the fact that disease of the brain may produce appearances in the retina similar to those of nephritic retinitis, as the following cases demonstrate. Both cases were observed during life, and the post-mortem conditions were studied in a thorough and competent manner. The broad facts are that a female, aged twenty-three, exhibited in both eyes the appearances which belong to the most complete picture of Bright's disease, had no albumen or other evidence of kidney-trouble, and not until a short time before death had she any symptoms to cause suspicion of brain-disease. The autopsy disclosed a tumour at and in the region of the septum lucidum. Another girl, aged fifteen, had the same ophthalmoscopic symptoms, with clear signs of Bright's disease, and, having died, gave opportunity for microscopic examination of the retina and optic nerves.

Retinal appearances identical.

The features common to both cases, in the ophthalmoscopic picture, were great swelling of both optic nerves, redness and infiltration, edges indistinct, vessels swollen—in the case of tumour there was ecchymosis of one papilla; near the nerve, opaque white patches of the rounded form, and dotted edges, seen in nephritic retinitis; at the macula the usual radiating figure, extravasations of blood in various places. Both cases were as similar as two cases of the same disease could be, and were studied by Graefe and others.

Structural changes similar.

In the tumour patient, the ocular lesion was confined strictly to the eye—the optic nerve-trunks, close up to the globes, possessed a normal structure as seen by the microscope. The lesions in the retinæ in both cases were extremely alike, making the diagnosis by the microscope almost as impossible as by the ophthalmoscope. There were in both cases sclerosis of the fibres of the optic-nerve layer—the ganglion cells atrophied or sclerosed—the granular layers studded with or almost transformed into fat granule-cells—hypertrophy of the connective tissue of the nerve and retina—blood-discs, and brownish pigment—the choroidal vessels were somewhat sclerosed. The only difference in the two cases was that, in the patient with cerebral tumour, the swelling of the retina belonged more to hypertrophy of the inner retinal layers and papilla, while in the patient with Bright's disease the swelling affected principally the radiating fibres of the external granular layer. In neither case could the rods and cones be well examined, because of cadaverous changes.

Difficulties of diagnosis.

The outcome of the matter is, that we cannot any longer assert the infallibility of diagnosticating Bright's disease by the ophthalmoscope. Many good observers have denied the possibility of mistake, and have recorded their opinion (*vide* Liebreich, Mauthner, &c.), but the retinal pictures may be completely simulated by neuro-retinitis from cerebral tumour, and from diabetes mellitus, malarial and alcoholic poisoning. Graefe records a case of cerebral tumour producing the retinal lesions in question,* and states some minutiæ for differential diagnosis, but these points are rendered valueless by the two observations above recorded.

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* "Archiv f. Oph." B. xii., 2, 120.

We are therefore compelled to examine the urine as well as the eye, and to study the signs of cerebral disturbance, however obscure they may be in some cases. But it remains true that the retinal lesions above described do belong in the large majority of instances to Bright's disease. A point to be studied is, what causes the neuro-retinitis in some cases of Bright's disease?—Can there be any analogy to the incarceration which belongs to the pathogenesis of the *Stanung's papilla* in neuritis descendens?*

RETINITIS PIGMENTOSA.

RETINITIS PIGMENTOSA (Plate VII. Fig. 2) is said to be most commonly met with among the offspring of persons nearly related to one another;† but this can hardly be the cause of the disease among the natives of India, as they are most scrupulous in observing the restrictions they place upon the intermarriage of relatives; and yet I have seen a considerable number of instances of this disease among native patients. The disease is, however, hereditary, and occurs therefore frequently among several members of a family. Free colouring matter from the blood may be deposited in the retina, giving rise to the formation of black, irregular-shaped bodies, and ultimately to atrophy of its nervous structure; but these cases are not to be confounded with those now under consideration.

Differs from pigmentary deposits.

In the majority of instances of retinitis pigmentosa which I have seen, there has been a history of impairment of vision commencing soon after birth, not sufficiently marked to attract much attention in early life; nevertheless, if careful inquiries be made, a history of defective vision may usually be traced. I am disposed to look upon the disease as one of the results of inherited syphilis. I have never been able to refer these symptoms to the effects of any of the so-called inflammatory changes; the disease seems to me to be one of a degenerative character, progressing very slowly, and often becoming stationary for years. The facts which in my mind are opposed to the relation of retinitis pig-

Vision impaired from childhood.

Probably of syphilitic origin.

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* Idem, Bd. xv., Abth. 111, s. 253-275.

† "Atlas d'Ophthalmoscopie," par le Dr. Liebreich, p. 16.

mentosa to syphilis are, that I have not noticed the notched teeth of syphilis in this disease, and it does not seem to be influenced by any treatment with which I am acquainted.

Case confirming this view.

Since the first edition of this work appeared, my attention has been directed to an account of "A peculiar form of Retinitis Pigmentosa in connexion with inherited Syphilis," by Mr. H. R. Swanzy, who quotes some observations by Mr. Hutchinson, as to the occasional syphilitic origin of this malady. Mr. Swanzy's patient was a child, aged eleven years and a half; there was imperfect vision of the right eye and hemeralopia, but no concentric contraction of the visual field. Numerous pigmentary deposits occupied the retinal periphery, and changes in the choroid were commencing. The deposits differed from those of ordinary retinitis pigmentosa in their form, and in not following the vessels. The child's teeth and the family history afforded unequivocal evidence of inherited syphilis.*

Symptoms.

Not striking.

Loss of sight after sunset.

Periphery of retina first affected.

Symptoms.—As I have before stated, although retinitis pigmentosa is a disease which commences in early life, it may long escape notice. It runs its course, in fact, without the slightest pain, and the external appearance of the affected eye is probably healthy. The symptom first complained of is a gradual loss of sight, most marked after sunset, or when the patient is subjected to a dim light. The central portion of the retina remains unaffected long after its peripheral parts have been destroyed; direct vision, therefore, remains comparatively good, while objects immediately around the central portion of the visual field are hazy, or even imperceptible. For this reason a patient suffering from this malady may be able to read small type, but cannot walk about with safety.†

Contraction of visual field.

Pupil active.

As the disease progresses the field of vision steadily contracts, and ultimately the patient's sight is almost lost. Notwithstanding this, until an advanced stage of retinitis pigmentosa, the iris may remain healthy, and the pupil, though greatly contracted, respond to the stimulus of light.

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* *Ophthalmic Notes*, by H. R. Swanzy, M.B., p. 7. Dublin, 1871.

† Dr. Mooren on "Retinitis Pigmentosa:" *Ophthalmic Review*, vol. i. p. 51.

Opacity of the lens.

Opacity of the vitreous is rare in this disease, but the lens is more often affected, the opacity commencing at its poles.*

Pigment spots on retina, spreading from its vessels,

On examining the eye with the ophthalmoscope in the early stages of the disease, the optic disc and retinal vessels appear of normal size; towards the ora serrata patches of colouring matter may be noticed. These spots seem to grow from without the walls of the vessels—that is, the external coat, particularly of the smaller vessels, is lined with pigment, and the calibre of the vessels themselves is often diminished from the thickening of the membrana limitans. Other authorities consider that the pigment matter seen in the retina is an infiltration of choroidal pigment into the part, and no doubt, in some instances, pigmentary deposits are thus produced in the retina; but it appears to me that in retinitis pigmentosa the colouring matter is formed in the retina itself, spreading at the expense of its proper structures; and, indeed, there are good reasons for supposing that the black spots are simply the result of a progressive atrophy of its nervous elements.

the product of nervous atrophy.

Experiments of Mantegazza.

The experiments of Mantegazza seem to throw some light on this kind of degeneration. It appears that "the transplantations of Brain substance in the frog are chiefly remarkable for the quantity of pigment, either under the form of round or oval cells, or in that of the more common stellate and irregular shapes; such a condition is a frequent result, it might indeed be called a pigmentous degeneration."† We can suppose that similar changes may, under certain circumstances, be set up in the retina during life; and it is more probable that such should be the case, rather than that the pigment formed in the retina in this disease is derived from the choroid.

Choroid atrophied.

It is nevertheless true that as the pigment spots grow in the retina, changes may be observed in the stroma of the choroid: it becomes atrophied, and the circumference of the optic disc is consequently flattened, the calibre of the choroidal vessels is contracted, but their channels are not closed, so that the dioptric media remain comparatively transparent.

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* Idem, vol. i. p. 49.

† *British and Foreign Med.-Chir. Rev.*, July, 1867, p. 163.

Extension of pigment spots.

Atrophy of retinal vessels.

With the further progress of the disease, the black pigment spots continue to increase in the retina, spreading gradually from the periphery to the axis of the eye; the retinal vessels become atrophied, and ultimately, when the patient has nearly lost his sight, the eye presents the following appearances:—Optic disc of normal size, and of a pale rose colour, looking flat, and no choroidal margin to be seen; the retinal vessels have dwindled away to mere threads, extending probably only a short distance beyond the margin of the disc; the fundus of the eye has a mottled appearance, the choroidal vessels are exposed, and a number of black, spider-shaped bodies are scattered over it; these are particularly distinct towards the ora serrata, Plate VII. Fig. 2.

Prognosis.

Total blindness rare.

No known remedy.

Prognosis.—I do not remember to have met with a case, in which a person, under forty years of age, has been rendered completely blind from the effects of this form of disease. It usually takes years to advance from the stage characterized by the symptoms of hemeralopia to that of general impairment of vision; but its progress, though slow, is sure. I have tried every means in my power to stop it, but have never succeeded in doing so; the atrophy of the choroidal stroma, and the increase of the pigment in the retina, continuing in spite of our best efforts.

Prognosis bad.

We must, therefore, give an unfavourable prognosis to patients suffering from retinitis pigmentosa; we may console them with the fact that its development will be slow, and may possibly be arrested by nature for several years at any stage; but beyond this, no reasonable hope can be entertained of improvement, much less of recovery.

RETINITIS APOPLECTICA.

Characterized by hæmorrhage.

RETINITIS APOPLECTICA.—This form of retinitis is generally met with among patients suffering from causes affecting the equilibrium of the general circulation; as, for instance, disease of the heart, liver, or uterus; obstructions of a local character, such as tumours or other growths pressing on the optic nerve and its vessels, may give rise to symptoms of this disease. The characteristic feature of retinitis apoplectica is indicated in its appellation: for in addition to the features presented in cases of idiopathic retinitis, we have more marked extravasation of blood into the retina; the effusion is in some instances so great as to burst forwards into the vitreous, or it may be backwards into the choroid. The hæmorrhage may spread over the optic disc.

The extent of loss of sight in cases of this kind depends on the amount and position of the effusion of blood into the retina; but in offering a prognosis we must remember that the cause of the disease being generally constant, improvement in vision is too apt to be followed by a relapse, consequent on fresh extravasation of blood into the retina. P. 401.

Detachment of Retina.

Detachment of the Retina from the choroid may arise, either from the effects of a blow on the eye, or from disease. I had lately an instance under my care of the former class of cases.

Case. Partial; following a blow.

Detachment from a Blow.—The patient had been struck with a racket-ball on the left eye; immediately after receiving the blow, he found he had completely lost the sight of the eye. When I first saw this gentleman I observed that the pupil was widely dilated; he could only distinguish large objects in certain directions, the injury evidently being in the axis of vision. On examining the eye with the ophthalmoscope, a considerable portion of the retina, extending from the optic disc outwards and downwards, was found to be detached, and below this a clot of blood could be seen over which the retina appeared to hang. The fundus of the eye was intensely congested, as well as the optic disc, and there were several spots of extravasated blood scattered over the retina.

Appearance of retina.

Extravasation.

Improved by time and rest.

I recommended this patient to keep the injured eye closed, and to rest the other one as much as possible. In a month's time I again saw him; the sight had improved, and the congestion and extravasation had almost disappeared: a considerable portion of the large clot noticed in the lower part of the eye had also become absorbed, but the appearance of the detached retina in the axis of vision remained unchanged.

Complete detachment.

It occasionally happens that the whole of the retina is dragged away from the choroid, and assumes a funnel-shaped form, the apex being at its point of attachment to the optic disc. The vitreous, however, must have passed into a fluid condition, to allow of the retina falling forward in this way.

Complete or partial detachment of the retina can

Appearance of retina.

State of vessels.

hardly be mistaken for any other disease; the retinal vessels may be traced up to the margin of the wound, where they will be seen to terminate abruptly, or bend back, as in the above instance, at the point at which the detached retina deviates from the plane of the fundus of the eye. It is seldom necessary, however, to resort to minute distinctions of this kind, in order to determine the nature of the case. The jagged wound in the retina either leaves bare the hexagonal cells of the elastic lamina, or else, these having been destroyed, the choroid is exposed, and very frequently the white glistening sclerotic behind may be seen through the rent.

Separation of retina from effusion.

Detachment of the Retina from Effusion.—Separation of the retina from the choroid, the result of a collection of fluid behind the former structure, is not necessarily accompanied by any pain in the eye; but this symptom will of course vary with the nature of the cause which has given rise to the effusion. The patient probably complains only of gradually increasing imperfection of sight; and as only a portion of the retina is usually detached, the field of vision is more interrupted than absolutely destroyed; so that in looking at an object immediately in front of him the patient will lose perhaps half the figure, the rays which fall on the detached portion of the retina not being recognised, and for the same reason, objects appear to be bent, or their outlines distorted in various ways. In other cases the patient first notices that the field of vision is cloudy, the cloud having a wavy motion, due to changes of position of the retinal elements which receive and localize the impression of light. Vision is not only distorted, but objects under examination are fringed with a coloured ring or halo; this condition is characteristic of effusion and detachment of the retina.

Field of vision interrupted.

Worse if near the maculr lutea.

If the retina be detached at or near the macula lutea, the impairment of vision will of course be far greater than if a more extensive detachment exist at its periphery; but even then, in certain directions, the visual field may still remain tolerably perfect.* Under any circumstances the patient complains of coloured or white balls, fiery wheels, flashes of light, and such like phenomena due to excitability of the visual organ.

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* M. Wecker, "Maladies des Yeux," vol. ii. p. 364.

If under these circumstances, a portion of the retina only has been torn away from the choroid, the detached piece will be seen (with the ophthalmoscope by means of the direct method of examination) bulging forward into the vitreous chamber, like a small bladder; its surface is usually relaxed and folded, trembling with every movement of the eye. The colour of the detached tissue varies: in the early stages of the disease it remains transparent, looking like a grey film upon the background formed by the choroid. By degrees, however, the nervous tissue degenerates and becomes opaque; in fact, the same changes occur as I described in cases of œdema. The opacity generally extends rather beyond the border of the actual line of detachment of the retina, and this border is deepened if the detachment be prominent, as a shadow is then thrown over the neighbouring fundus.

Detached portion seen to bulge forwards.

Looks grey.

If doubt exists as to the nature of the lesion, employing the indirect method of examination, we must follow up the retinal vessels from the optic disc to the point of apparent separation of the retina, and we shall notice that the vessels passing over the bladder-like projection are on a plane anterior to that of the fundus of the eye; and accordingly we shall have to alter our focal distance to see them distinctly. As they dip down on the other side of the projection they will again be indistinctly seen, till we re-adjust the focus. The calibre of the vessels as they pass over the retina is seldom altered, the vascular system being unimpaired; but to the practised eye, the vessels passing over the effusion have an undulating movement imparted to them on every slight turn of the eye: an appearance which, together with the bulging forward of the retina, cannot be mistaken if the detachment is considerable; but, on the other hand, requires much practice and dexterity to recognise if the detachment be only slight. The separation of the retina from the choroid may take place, apparently without any appreciable structural changes in the other tissues of the eye; on the other hand, it may be complicated with inflammatory or other abnormal appearances.

Displacement of the vessels.

Circulation maintained.

Wavy motion of vessels.

Detachment of the retina,[*] such as I have now

Separation usually below.

described, is generally noticed at its lower portion; this fact is explained by supposing that the fluid behind it gravitates downwards, and accumulating in the inferior part of the retina, produces these appearances. Occasionally this fluid contains blood, or pus, which will of course alter the apparent colour of the detached part. Particles of lime and small plates of bone have been found lining the inner surface of a detached portion of the retina. But in detachment of the retina from serous effusion beneath it, there is no increased tension of the eyeball; but if the detachment results from the growth of a tumour in the choroid, the tension of the globe of the eye is invariably augmented.

Effusion of blood or pus.

Prognosis: unfavourable.

Prognosis.—The prognosis of these cases of detachment of the retina is unfavourable: some few cases remain stationary, others have been said to recover; but in by far the majority of instances the effusion behind the retina increases and causes irreparable damage to the eye.

Treatment.

Treatment,—Total loss of sight must be the inevitable result of an accumulating effusion behind the retina, and its separation from the choroid, unless the surgeon can quickly afford some relief to his patient. Fortunately this may be done, as has been proved by Von Graefe, and Mr. Bowman.* Their mode of treatment is to pass two needles from without through the effusion, so as to let it escape into the vitreous, or externally into the choroid. Successful cases of the kind are sufficiently numerous to allow of our admitting this proceeding into the list of approved ophthalmic operations.†

Puncture the sac from sclerotic.

First determine state of retina.

Before adopting this measure, however, in any particular case, it is necessary to determine whether the retina is comparatively healthy, so as to lead us to hope, in case the effused fluid is got rid of, and the retina restored to its normal position, that our patient will gain some advantage from the operation. We may judge of this pretty accurately by the appearance of the retina; if it looks dull and opaque, it is more than probable that its nervous elements have degenerated, and in that case it will be of no use interfering.

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* *Ophthalmic Hospital Reports*, vol. iv. p. 135.

† Mr. Haynes Walton on Detachment of the Retina: *Med. Times and Gaz.*, 1866, vol. ii. p. 311.

Operation.

Our intention in operating should be, to make a free opening through the effusion, so as to allow it to escape into the vitreous chamber; the retina will then fall back into its normal position, and unless structurally altered, its functions may be restored and the patient regain almost perfect vision. The plan Mr. Bowman recommends appears to be the best adapted for this purpose:—The site of the separation of the retina having been carefully studied with the ophthalmoscope, the patient is placed on a couch; and a stop speculum having been introduced to keep the lids apart, the surgeon passes a needle through the sclerotic vertically into the eye, transfixing the retina at its point of separation from the choroid; another needle is then inserted through the same opening, and the handles of the two being separated the one from the other, their points are made to diverge like the blades of a pair of scissors. In this way the retina is torn through, and the fluid behind it escapes into the vitreous chamber; usually a small quantity passes out along the needles, and exudes beneath the conjunctiva, but this is not always the case. After the operation the retina falls back into apposition with the elastic lamina.

Directions.

Retina torn by two needles.

Avoid wounding lens.

In these cases, the chief point to attend to is to avoid wounding the lens; but an ordinary amount of anatomical knowledge and skill will prevent this accident, and if we do not touch the lens, we may be sure that no injury will result from passing the needle into the vitreous, even if we do not succeed in effecting a cure. After the operation, the only necessary treatment will be to keep the eye closed for a few days with a pad and bandage.

Detachment from staphyloma.

Detachment of the Retina from Staphyloma and Fluid Vitreous.—Besides detachment of the retina brought about by blows on the eye, and serous effusion between it and the choroid, other causes may produce a similar result. I mentioned one of these when discussing the subject of sclero-choroiditis anterior, observing that, as the sclerotic gradually yielded to the intra-ocular pressure, the choroid, being drawn into the staphyloma, might drag the retina after it, thus detaching it from its normal

From fluidity of vitreous.

position. A similar result occurs at times in posterior staphyloma; but in this last affection, in addition to the mechanical effects produced by the protrusion backwards of the sclerotic, there is a tendency to general congestion of the choroid, and a fluid state of the vitreous, which may itself lead to detachment of the retina.

A like alteration in the consistency of the vitreous has been known occasionally to follow severe contusion of the eye, and such an accident may, therefore, give rise to detachment of the retina. Under these circumstances the alterations in the consistency of the vitreous appear to progress with remarkable slowness, so that the fact of the injury may be almost forgotten; but symptoms of gradual impairment of sight, and constant muscæ floating about in the field of vision, attract the patient's notice, and we find on examining the eye that a fluid state of the vitreous exists, and detachment of the retina has commenced.

EMBOLIA OF RETINAL VESSELS.

In aortic disease.

Symptoms sudden.

EMBOLIA OF THE RETINAL VESSELS.—The details of a case of this disease, and two plates illustrating it, are to be found in Liebreich's Atlas.[*] In the majority of the recorded instances, embolia of the retinal vessels has been met with among patients suffering from disease of the aortic valves.[†] The symptoms commonly appear suddenly, in a person who has previously enjoyed good sight: probably the patient has gone to bed perfectly well, and on rising in the morning discovers that he is almost blind in one or both eyes.

Changes in the fundus.

On making an ophthalmoscopic examination, the optic disc will appear of its normal size, and though rather pale, in other respects unaltered; the same remark applies to the retina. It is in the vascular system that we shall discover the most marked changes to have taken place; the arteries and veins, either in the whole or in a portion of the fundus of the eye, will be found to be very much contracted; the circulation seems almost to have ceased, and the vessels to have collapsed, except in one or two spots where they are distended with blood; this is chiefly noticed in the veins. The blood may be seen to move slowly on towards the optic disc, the walls of the vessels contracting behind it, and this contraction lasts till another wave passes through the vessel in a similar way; a sort of peristaltic movement is thus induced, which may be general, or confined to certain veins.

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[*] "Atlas d'Ophthalmoscopie," par le Docteur R. Liebreich, p. 23, Tab. VIII., Figs. 4 and 5.

[†] *Lancet*, vol. ii. p. 491 for 1875. Mr. E. Nettleship "On Embolism of Central Artery of Retina."

Vessels contracted.

Slow peristaltic circulation.

If the obstruction to the circulation continues, changes occur about the region of the yellow spot, due to serous effusion and fatty degeneration of the elements of the retina; the part becomes opaque and cloudy, the opacity shading off into the healthy retina.*

Retinal degeneration.

Virchow has described and explained the cause of these phenomenæ in the circulation; he believes they arise from the presence of small coagula (emboli) in one or more of the retinal vessels; they are most commonly met with near the lamina cribrosa. In some cases, the walls of the vessels have been found thickened and otherwise diseased.

Emboli found in the vessels.

Case.—A typical case of the kind is quoted by Zander from Ed. Jaeger. The individual was an old man, seventy-two years of age, the subject of hæmorrhoids. The ocular media, he states, "were perfectly transparent, the retina appeared of a medium yellowish-red, without visible morbid change. The optic nerve, slightly pigmented at the circumference, and somewhat yellow-tinted, exhibited slight indications of bluish spots.

Case.

The vascular system of the retina, generally of small development, exhibited to the large trunks more especially, a proportionably small diameter. The corresponding large arteries and veins were equal in diameter, and alike in their dark red colour. No double contour was apparent, so that veins and arteries could only be distinguished by their clearly visible, respectively centripetal and centrifugal, circulation. This had not the appearance of a pulsation, since the walls, especially of the larger vessels, remain undis-

Contracted vessels.

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* "On the Use of the Ophthalmoscope in Diseases of the Nervous System." By Dr. T. C. Allbutt, p. 293.

Irregular circulation.

turbed; but it was a movement slower or quicker, uniform or interrupted, but not rhythmical, of an unequally coloured stream of blood.

In larger vessels stagnant.

In the larger vessels, the blood-stream exhibited, at distances of from one-fourth to the whole diameter of the vessels, intervals of lighter and darker red colouring; which, however, in the movements of the column, were continually changing, the lighter spaces becoming smaller and wholly disappearing, to be formed anew elsewhere. The movement of the blood appeared in such places uniform, but extremely sluggish. In the vessels of medium size the movement was quicker, and often for a short time pulsatile; the light intervals were of a paler red, and, as well as the dark portions, of a greater comparative length, being from twice to four times the diameter of the containing vessels. In the finest twigs visible upon the optic nerve, the movement of the blood was most rapid, and, at the same time, most disturbed. The extremely delicate stream of blood would be suddenly interrupted, the dark red part of the blood would disappear, and the little vessel, scarcely discernible upon its bright ground, would seem to have assumed the tint of the optic disc. Then, in interrupted course, a shorter or longer column of blood would pass through the vessel, followed at greater or less intervals by a larger or smaller mass of blood globules, so that the observer almost appeared to see single globules, and then suddenly the vessel would be filled in its whole course with dark red blood, the portions of which seemed rather to roll through than to flow quietly.

In medium sized less so.

In finest, quick, but interrupted.

In the medium-sized and smallest vessels not the slightest movement was visible; but in the large, by careful attention for one or two minutes, the lighter parts might be seen to diminish and disappear, at the same time reappearing in another place."*

ISCHÆMIA OF RETINA.

ISCHÆMIA OF THE RETINA is indicated under the following circumstances:— The patient usually becomes suddenly blind without any apparent cause; the pupils are widely dilated, but beyond this the eyes (for both are usually involved) have the appearance of health.

Loss of sight and dilated pupils.

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* Carter's translation of Zander "On the Ophthalmoscope," p. 137.

Retinal arteries empty.

On examining the retina with the ophthalmoscope the retinal arteries will be found almost empty, "dwindled to the size of hairs," and the veins distended. In all other respects the appearance of the fundus of the eye is natural.*

Pathology obscure.

The pathology of ischæmia of the retina is very obscure. The patients have generally been weak and anæmic subjects, and it is possible that embolism of some of the larger vessels may have induced these symptoms. In one instance a tumour of the brain was discovered after death, and in another the anæmia was only the first step in that degeneration of the retina which depends on Bright's disease.

Paracentesis of the cornea.

Treatment.—When the disease appears to depend on mechanical causes, paracentesis of the cornea, or iridectomy, has been followed by relief. But until we are able to discover the causes of the deranged circulation through the vessels of the retina with more certainty than we can do at present, our treatment must of necessity be unsatisfactory.

ATROPHY OF RETINA

After retinitis.

Black patches.

Vessels atrophied.

Papilla involved.

ATROPHY OF THE RETINA may be the termination of any one of the affections of this structure we have been considering; if the atrophy has been preceded by inflammation, the scarlet colour of the retina gradually disappears, and the fundus of the eye, in the native of India, becomes covered with black patches, the remains of the epithelium of the elastic lamina and choroid. In the early stages of atrophy, the calibre of the retinal vessels diminishes, and as the disease advances, they dwindle away to mere thread-like streaks. If the optic nerve is not involved in the disease, it retains its normal appearance; but in the majority of cases it becomes atrophied also, and then presents a white, glistening, and slightly depressed appearance which is very characteristic.

I need hardly add that, if atrophy has taken place, we know of no remedial agents which can restore the nervous structure of the retina; it becomes converted, in fact, into a fibro-cellular tissue. Excluding retinitis as a cause of atrophy, this change most frequently follows diseases of the choroid, or arises from intra-

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* Two cases of this form of disease will be found reported by Prof. Rothmund: *Ophth. Hospital Reports*, vol. v. p. 367.

Other causes of atrophy.

ocular pressure as in glaucoma; atheromatous disease of the blood-vessels, and embolism, are also causes of atrophy of the retina, and lastly the nervous tissue may become atrophied from long-continued disuse, or from disease of the brain and optic nerve.

GLIOMA.

Origin in the neuroglia.

TUMOURS OF THE RETINA. GLIOMA.—There is only one form of tumour which it will be necessary to notice under this heading—viz., Glioma (Virchow). This morbid growth originates in the *neuroglia*, or delicate interstitial matrix of the brain, retina, and other nervous structures.*

Gliomata of two kinds.

The gliomata are of two kinds, soft and hard. The soft variety are composed of a finely granulated intercellular substance and cells, [illegible]e latter in size and appearance resembling pus cells. In the harder form the intercellular substance is fibrillated, and the cells, though small, are fusiform, containing fine shining nuclei. The nervous elements are not involved in the morbid process, but frequently undergo fatty degeneration; it is the neuroglia however which is affected by the localized hyperplasia, its cells being excessively increased in number.

Slow growth, non-malignant.

Microscopic characters.

These tumours are of slow growth, and it is doubtful if they are malignant. Gliomata, however, infect neighbouring structures, and have a tendency to fungate, so that they may be mistaken for cancer unless carefully examined under the microscope. It is by the size of the cells that we shall be chiefly guided; so long as they do not exceed those of the connective tissue they may be considered as gliomatous, although the mass may have formed a fungous excrescence; but if the cells exceed this size, the tumour must be referred to the sarcomatous group.

The prognosis to be formed in glioma is unfavourable, although less so than in cancer. It is of course necessary to remove the entire morbid growth, or it will in all probability recur.

Case.

Case.—The following case illustrates the course and treatment of glioma of the retina:—

Ashruf, aged six, was brought to me at the Ophthalmic Hospital, and presented the following conditions:—General health good: the pupil of the right eye was widely dilated, and a yellow reflection from the fundus could be seen, evidently proceeding from a morbid growth which projected into the vitreous chamber.

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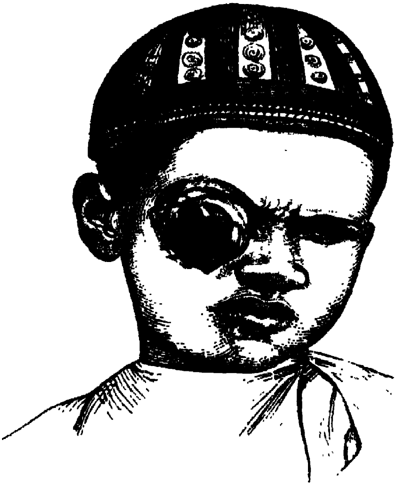
* "Die Krankhaften Geschwülsten." V. R. Virchow, b. ii. p. 159.

Early appearances.

I advised the removal of the eye, but as the parents would not consent, the child was removed from the hospital. Twelve months afterwards they again brought him, and the right eye then presented the appearance delineated in Fig. 34. The child's health had fallen off, but the glands of the neck were not enlarged. The eyelids were greatly distended, and a fungating tumour was seen growing from the eyeball and protruding between the eyelids. Its surface was ulcerated, and bled when touched, but was usually covered with a crust of dried blood and matter.

Advanced growth.

Fig. 34.



From a Photograph.

I at once determined to remove the morbid growth, and there was little difficulty in accomplishing this, the child having been placed under the influence of chloroform. On passing my finger behind the tumour, I felt

Removal.

that the optic nerve was very much enlarged. I divided the nerve, therefore, as near the optic foramen as possible, and then applied the solid chloride of zinc to the bottom and sides of the wound. The child made a rapid recovery, and appears up to the present time to be perfectly free from the disease.

Examination of the tumour.

On examining the tumour, I found that the optic nerve was embedded in a morbid product, having all the characters above noticed as characteristic of the soft variety of glioma; the remains of the nerve fibres could be ready traced through the tumour. The globe of the eye was lined with a similar abnormal structure, which projected forwards through the sclerotic, giving rise to the fungoid mass which appeared externally; but the vitreous space was empty, or rather, unoccupied by the morbid growth. I carefully examined every part of this specimen, and in not a single instance did I find cells exceeding those of a pus globule in size, nor were there any fusiform cells among them

Remains of nerve-fibres.

Cells small and simple.

It remains of course to be seen if any of the tumour has been left in the orbit. From its history, I believe it commenced in the retina, as there was no protrusion of the eye when I first saw the child, and he has never shown any symptoms of disease of the brain. I cannot, however, but fear that the glioma may have passed along the neuroglia of the optic nerve to the chiasma, and that ultimately the brain will be involved; but at present no such complication has occurred. The sight of the left eye is perfect, and the child's general health has improved remarkably since the operation.

Result favourable.

It does not often happen that we have the opportunity of watching the growth of a tumour of this kind; but the dilated pupil and glistening yellowish-white reflection from the back of the eye, were sufficient to lead to a correct diagnosis in the early stages of this case. The ophthalmoscope may afford us much assistance in instances of the kind, and if employed sufficiently early would usually demonstrate the fact of the morbid growth being limited to one part of the retina, giving it a thickened and mottled appearance. Subsequently, as the disease involves the whole of the retina, the eye assumes the appearance formerly known as the "amaurotic cat's-eye." The morbid growth advancing bursts through the globe of the eye, and ultimately assumes the fungoid appearance depicted in Fig. 34.

There can be no question as to the necessity of removing the eyeball, and with it the morbid growth in cases of this form of disease.

FUNCTIONAL DISORDERS OF THE RETINA.

Hemeralopia.

Night Blindness or Hemeralopia.—The following extract, taken from a work stamped with the authority of Government,* gives a good, though marvellous, account of hemeralopia. Capt. Smith, R.N., reports that in September, 1801, the *Merlin* captured a Spanish privateer, and having been sent with twenty men to cruise in her as tender, he thus describes their adventure:—

Captain Smith's narrative of night blindness.

"In a few days, at least half the crew were affected with nyctalopia. We were chased one calm morning by a large Xebec, carrying from eighty to one hundred men, and towards evening she was fast pulling up to us, our people having been fagging at their oars many hours without any relief. Knowing that night would deprive half of our crew of sight, it was proposed to try our strength with the enemy while it was daylight; this was answered by three cheers. The oars were run across, and the enemy by this time being within gunshot, the action commenced. After a time, to our great relief, he sheered off and pulled away from us; we, in our turn, became the pursuers; but when night came on, we took special care to lay our head from the Xebec, and saw no more of her.

His method of treatment.

"This circumstance put me on devising some means of curing the people affected with night blindness, and I could think of none better than excluding the rays of the sun from one eye during the day, by placing a handkerchief over it; and I was pleased to find, on the succeeding night, that it completely answered the desired purpose, and that the patients could see perfectly well with the eye which had been covered during the day; so that, in future, each person so affected had one eye for day, and the other for night. It was amusing enough to see Jack guarding, with tender care, his night eye from any the slightest communication with the sun's rays, and occasionally changing the bandage, that each eye in turn might take a spell of

By covering one eye by day.

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* "Royal Naval Biography," 1835, vol. iv. Part II.

night duty, it being found that guarding the eye for one day was sufficient to restore the tone of the optic nerve, a torpor of which and of the retina is supposed to be the proximate cause of the disease. I much question whether any purely medical treatment would have had so complete, and, above all, so immediate an effect.

Referred to retinal exhaustion,

"Persons affected with nyctalopia become perfectly blind as night approaches, and continue so till the approach of daylight; the medical treatment is bleeding and purging, blisters applied repeatedly to the temples, close to the external canthus of the eye, cinchona bark, joined with chalybeates, &c., all of which was impracticable by us, having no medicine on board our little vessel. I am aware that this disease frequently attends scurvy in tropical climates, and is sometimes occasioned by derangement of the digestive organs and hepatic system, in which cases our simple treatment would be useless; but in the above instance it was evidently caused only by the sun."

and scurvy.

Although bordering on the marvellous, this account is, I think, worth recording, more particularly as I quite agree with Captain Smith as to the causes of hemeralopia; I believe it does occur from scurvy and over-stimulation of the retina.

No lesion apparent in hemeralopia.

We must exclude from this group cases of pigmentary degeneration of the retina, and in fact all diseases of the eye accompanied with structural lesions, which in themselves account for the night blindness; as, for instance, opacities of the vitreous, lens, and cornea, myosis, and such-like affections, and simply confine our remarks to cases in which marked diminution in the acuteness of vision exists when the patient is removed from a bright light, and yet in which we can discover no lesions of the retina or of the dioptric media to account for the phenomena. Instances of the kind are common in the tropics.

Patient cannot see in a dim light.

In hemeralopia the patient is not only blind at night, but at all times if taken into a room dimly lighted; he can see comparatively well in bright moonlight, or in a well-lit room. Hemeralopia evidently therefore arises from a state of torpor or exhaustion of the retina, which, under these circumstances, requires a greater number of luminous rays to produce a sensible impression than in the healthy eye.

The retina torpid.

Causes.—This condition of the retina may be brought about by general anæmia and imperfect nutrition, or by intense excitation of the nervous structures, and consequent exhaustion; probably a combination of these causes is the most prolific source of hemeralopia. A patient, whether from bad food, impure air, or disease, falls into a state of anæmia, and if he be then exposed to the intense glare of a tropical sun hemeralopia is the result. It is unnecessary for me to cite instances to prove that such influences are a cause of night blindness, it being well known that sailors returning from a long voyage in the tropics, and predisposed to scurvy from ship-diet, are not unfrequently affected with hemeralopia; but direct exposure to the glare of the sun has hardly been recognised as a sole cause of night blindness.

From bad food and sun-glare, or exposure to the sun alone.

The Treatment of night blindness resolves itself, therefore, into endeavours to restore the nutritive functions by suitable diet, and such means as iron and strychnine, and, when required, by antiscorbutic remedies, giving the eye rest at the same time. If these objects are kept in view, I have never seen a case of hemeralopia that has failed to recover; provided, of course, that the patient has not been suffering from some incurable disease of the liver, kidneys, or other important organs of the body. In making this assertion, I restrict myself, in fact, to cases of hemeralopia in the limited sense above indicated, and not to cases in which the night blindness depends upon other and assignable causes.

Treatment. Tonics, food, and rest.

SNOW BLINDNESS would appear to arise from somewhat the same causes as hemeralopia, the glare from the snow causing over-excitation, and ultimately loss of sentient power in the retina. The affection, however, is only transient, and usually passes away after the removal of the cause of the disease.*

SNOW-BLINDNESS. Retinal exhaustion.

Dr. H. Cayley gives the following account of snow blindness. He writes:—

"As I was crossing the 'Zoji La' pass from Cashmir to Ladak early in May, I had the opportunity of seeing many cases of snow-blindness, and a brief description of the affection may be of interest.

Dr. Cayley's narrative.

"The day of crossing the pass, my party were on the

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* Kane's "Arctic Exploration;" Dr. Hayes' Report of Sledge Journey, Appendix, p. 489.

Symptoms:

severe pain.

Sight almost lost.

Intolerance of light.

Ophthalmia.

Treatment.

move for more than sixteen hours over fresh fallen snow the whole way, and soon after mid-day I noticed some of the servants and baggage coolies stumbling along with their eyes covered and protected as much as possible, and all complaining of intense burning and throbbing in the eyeballs, headache, and dimness of sight. I recommended what I had heard from natives of the mountains, and had myself found to give great relief—viz., the application of a handful of snow on the eyes for a few minutes, till the burning was removed, and repeating this at intervals. After the march was over, and during the night, all those whose eyes were affected, consisting of nearly half the party, suffered most acutely from deep-seated pain in the eyes and orbits, with more or less complete loss of sight; and many of the coolies, who were all hill-men, and accustomed to the snow, were sitting out in the cold night air, groaning with pain, but finding their sufferings less than in the smoky huts. The next morning two of the servants, and about twenty-five coolies, were suffering in a greater or less degree from the following symptoms: almost complete loss of sight; they could just see their way about, but some even were quite blind. The most intense intolerance of light; severe deep-seated pain and burning in the eyeballs and orbits, and generally bad headache. The other symptoms were profuse lachrymation, injection of the conjunctiva, and swelling and puffiness of the lids, and contracted and inactive pupils. Acute ophthalmia, in fact, with the symptom of nervous irritation especially prominent. In some only one eye was affected, but generally both, though not always in the same degree. In some the affection commenced after the day's march and exposure were over, but I think only in those who went into the huts, and were exposed to the irritating smoke of fires of wood and animal dung. The treatment I employed, and which gave great relief, was warm fomentations, and a lotion of equal parts of tincture of opium and water dropped into the eyes, and keeping the eyes covered with a wet bandage. The drops caused smarting for a few minutes, followed by great relief."*

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* *Indian Medical Gazette*, August 1st, 1868.

EFFECTS OF LIGHTNING.

Illustration.

LIGHTNING BLINDNESS.—Momentary exposure to a very bright light may induce impairment of vision, by destroying the sensibility of the retina. The captain of one of our coasting steamers consulted me a short time since on account of impaired sight, particularly marked at night. His vision had been perfect until within a few months of the time I first saw him; he was then at sea, and one fearfully dark and stormy night suddenly a vivid flash of lightning burst over the vessel: my patient states that for a few minutes afterwards he was perfectly blind, and although he recovered his sight to a great extent, it has since remained impaired. No abnormal appearance could be detected with the ophthalmoscope.

Similar effects from overwork.

The functions of the retina may become similarly injured from prolonged work on minute objects in a bright light, as in the instances of watchmakers and engravers, and yet the fundus of the eye may appear perfectly healthy.

DALTONISM.

Hereditary and incurable.

Certain colours only recognised.

COLOUR BLINDNESS, OR DALTONISM, in some instances comes under the class of diseases depending upon impairment of the functions of the retina, without any perceptible lesion in the nervous apparatus of the eye; on the other hand, colour blindness is frequently met with in the early stages of atrophy of the optic nerve. Excluding instances of this latter description one meets with cases from time to time, in which colour blindness appears to be a congenital and hereditary affection, and is incurable; the patient's sight may in other respects be perfect, but he is unable to distinguish between certain colours—red, orange, and yellow may not be distinguishable from blue, grey, or green, and in some few cases absolute colour blindness exists, black and white being alone recognised. In other instances the patient complains that all colours present a certain tint either of red, green, or some other colour; but this form of colour blindness is uncommon, except as a result of disease of the brain, or optic nerve, which we shall subsequently have to consider.

Dr. G. Wilson* states, that patients suffering from colour blindness can often distinguish colours by artificial light, better than by daylight; he points out

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* "Researches on Colour Blindness," pp. 118-127. Edin., 1855.

Importance in case of signal-men.

very forcibly the necessity of examining men employed as guards to railway trains, and in other similar situations, as to their power of distinguishing the various colours: a man may be affected with Daltonism without knowing it, and, if so, he is of course quite unfit for an employment in which the recognition of coloured signals is all-important. The ability, however, to discern colours, as I have above remarked, is impaired by various affections of the eye, for instance in some cases it follows commencing atrophy of the optic nerve. The colour to which such patients are most frequently insensitive is red, while blue is best preserved: green appears yellow or grey; rose and violet, bluish. The prognosis of the nerve affection is not modified by loss of colour perception. (*Vide* Amblyopia.)

As a result of disease.

HEMIOPIA.

HEMIOPIA, OR HALF-VISION, (p. 451).—The fibres of the optic tracts meet in the chiasma, those from the outer part of the right tract passing to the outer part of the right retina, and those from the inner part of the right tract supplying the inner half of the left retina; the left optic tract in like manner supplies the outer half of the left retina, and the inner half of the right retina. In consequence of this relation of the fibres of the optic tracts, mechanical causes, such as a clot of blood, or a tumour, interfering with the integrity of either optic tracts, may produce blindness confined to the inner half of one and the outer half of the other eye, while the remainder of both retinæ may be healthy. The defect in the sight is clearly indicated and must be carefully mapped out by a close scrutiny of the visual field of both eyes; it is thus only that we can arrive at a correct diagnosis of the case. If the disease be confined to one side of the brain, the limitation of the field of vision is often clearly defined, and should the history of the case point to the formation of a clot as the cause of the affection, we need hardly fear that the impairment of vision will extend; but the majority of these cases depend on tumours involving the chiasma, in which case both tracts are gradually implicated, and the patient's sight hopelessly destroyed. If the hemiopic contractions occur simultaneously or at a short interval from each other, the corresponding sides of the two retinas being affected, we may ascribe the disease to one root of the optic nerve.

From disease or compression of either optic tract.

By a clot of blood,

or tumour.

Homonymous or lateral hemiopia is, however, exceptional. The temporal halves, and, in rare cases, the nasal or upper and lower halves of each monocular visual field, are blinded. Temporal hemiopia is to be explained by hindrances to conduction in the optic fibres, which cross at the chiasma. We have no proof of the existence of other forms.*

Retina appears healthy.

In these cases of destruction of the nerve-fibres, occasioned by disease affecting the optic tracts or the brain, abnormal appearances are not often observed in the retina; it is this fact which distinguishes hemiopia resulting from paralysis, from that impairment of vision in which half of the retina has been detached or entirely destroyed from an effusion of serum or blood behind it.

Functional hemiopia.

Case.

Hemiopia sometimes appears as a transient affection, depending upon functional derangement of the retina. Dr. Wollaston's case is an instance of transient hemiopia; he remarks—"I suddenly found, after violent exercise two or three hours before, that I could see but half the face of a man whom I met; and it was the same with respect to any other object I looked at. In attempting to read the name Johnson over a door, I saw only . . . . son, the commencement of the name was wholly obliterated to my view." In this case the affection passed off in about a quarter of an hour.

Due to gastric irritation.

We meet with instances of this kind from time to time in practice; they generally come on with indigestion or headache, and are of little or no consequence, but may cause the patient much unnecessary alarm. On examining the eye with the ophthalmoscope no abnormal appearance can be discovered, the affection probably depending upon temporary loss of power in the nerve-fibres, or nervous matter, supplying half the retina of either eye. In some instances of hemiopia there is a marked defect of colour perception in the sound half of the visual field. In one case of this kind vision was nearly restored, but on the blind side the colour sense remained defective.

Treatment.

Treatment.—In that form of disease last described, we must direct our attention towards the removal of the source of irritation, which is usually gastric; but as I have before remarked, the affection is generally a very transient affair, and it will often be unnecessary to prescribe anything for it. In those far graver cases arising from actual destruction of tissue in the optic tracts, or nervous centres, we can seldom do much towards relieving the symptoms. We shall generally have sufficient evidence of the nature of the lesion from various concomitant symptoms, depending upon the disease of the brain, and it is to these our attention should be directed rather than to the state of the retina.

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* C. Stellwag von Carion, "Diseases of the Eye." By Hackley and Roosa, New York, 1868, p. 668.

Unsatisfactory in brain cases.

SCOTOMA.

A portion of retina insensible to light.

SCOTOMA (constant) signifies a form of partial blindness, in which only a portion of the retina is insensible to light, and this part often appears as a black speck to the patient, particularly when he is engaged in reading or any similar work. In these cases the rays of light are not prevented from reaching the retina, but they fall on certain parts of the fundus of the eye incapable of appreciating the stimulus of light, which hence appear as dark spots in the field of vision.

Appears as a black spot.

Moves with the eye.

One of the characteristic features of scotoma is, that the patient observes the dark spots to move exactly with his eyes, and not float about before them, as in *Muscæ volitantes;* thus, for instance, it will appear to follow the eyes as these are cast along the lines of a book in reading or writing, as it were covering a part of the line; in fact, we may generally detect the presence of a scotoma, by making the patient look through a small aperture at a sheet of white paper, upon which he will generally perceive a black spot projected, if a part of his retina is insensible to light. Scotomata vary much in form and figure, being described as discs, lines, stars, and so on.

Its position important.

The position of the scotoma will very much influence its effect on the patient's sight: if at or near the yellow spot it will be most annoying, constantly interfering with the perfection of vision. On the other hand, if the scotoma be eccentric, it may cause but little inconvenience, and hardly any at all in reading or writing; but, when looking at a distant object, the patient will probably notice a hazy or misty appearance over a portion of the field of vision.

Causes:

Scotoma may arise from congenital defect, a portion of the retina being imperfect or wanting; but these

Congenital defect.

Retinitis.

dark spots are far more commonly the result of inflammation of the retina and choroid. In this case the ophthalmoscope may reveal to us the nature of the disease; it may be that a spot of atrophied retina, or one infiltrated with choroidal pigment, will thus be seen, and account satisfactorily for the symptoms of which the patient complains.

Disease of the nerve or brain.

In other cases scotoma may be induced by paralysis of some of the fibres of the optic nerve or tracts, or destruction of a very limited portion of the brain; in which case, although the portion of retina supplied by these fibres will be absolutely insensible to light, still we may be unable to perceive any alteration in the fundus of the eye by means of the ophthalmoscope. In cases of this description, the scotoma generally comes on suddenly, and the affected portion of the retina if not absolutely insensible to light, may be incapable of appreciating colours (see page 429): in fact, it often happens that a certain portion of the retina may be affected with colour blindness, in the first instance, and subsequently become dead to the stimulus of light without our being able to detect anything wrong with the eye by means of the ophthalmoscope.

Prognosis bad in old cases,

or if attended by structural changes.

Should a scotoma have been observed by the patient for some considerable time, it is seldom that the black spot subsequently disappears, whether it arises from an affection of the brain or retina, especially if symptoms of commencing atrophy of the disc are present. But if the spot has only recently appeared the case will not be so hopeless, and our prognosis and treatment will be very much guided by the aid which the ophthalmoscope affords us. A central scotoma is always more serious than one, though it may be of large size, in the periphery of the retina. If no morbid changes are detected in the eye, probably the disease depends on some affection of the nerve; or we may suppose that a limited portion only of the optic tract is involved; and in these cases we may hope for some improvement. I need hardly say that no such favourable prognosis can be formed in a case of partial atrophy of the retina, or where its nervous structure has been invaded by pigmentary formations from the choroid. On the other hand, absence of atrophic symptoms in the optic nerve or retina does not exclude an unfavourable result.

Clots of blood may disappear.

Blood clots are sometimes a cause of scotoma, and may be detected with the ophthalmoscope; as they are absorbed, the part gradually recovers its functions. The same remark applies to limited serous effusions behind the retina, provided the nervous tissue does not appear to be atrophied, having lost its transparency over the seat of effusion.

DISEASES OF THE ELASTIC LAMINA OF THE CHOROID.

DISEASES OF ELASTIC LAMINA.

Epithelium hides choroid in Hindoos.

THE ELASTIC LAMINA is an homogeneous membrane, separated from the sclerotic by the vascular network of the choroid and ciliary processes, and internally it is lined by a layer of epithelial cells, which in the eye of the native of India are full of black pigment, so that the structures behind these pigment-cells cannot well be seen till they have been removed. Yet we frequently see the vessels of the choroid looking as if injected with vermilion, and placed on a black background. Under these circumstances, therefore, the hexagonal cells of the elastic lamina must have been destroyed, or in some way removed.

Vessels exposed in disease.

It is possible that, from congestion of the vessels, the epithelial cells may be pushed on one side, so as to expose the vascular network of the choroid behind them; but although it be admitted that these cells are elastic, and capable of separation from one another, still, I believe that in the eye of a native the vessels of the choroid are seldom thus brought into view, unless the cells are destroyed. It is by no means an uncommon thing to meet with instances in which the epithelium has been thus completely broken up, patches only of it being left scattered over the surface of the lamina.

Epithelium not essential to sight.

Its probable function.

ABSENCE OF EPITHELIUM.—These pigment-cells may be destroyed and the patient's vision remain but slightly impaired. No doubt the epithelium is placed there for some important purpose, though I am not aware of what its precise functions may be; but this much is certain, that the pigmented epithelium must absorb a number of the rays of light which enter the eye; and in a tropical climate, where the glare of the sun is excessive, they would perhaps be a protection to the retina.

M. Bravais observes that correct vision can only

Views of M. Bravais.

exist with clear images on the retina; but that images formed by direct rays may retain their clearness even when reflected, if every reflected ray re-crosses the retina exactly where it has already traversed it. This condition is fulfilled wherever the reflecting surface is in contact with the sensitive screen. Every ray of light, according to this authority, which has traversed one of the cones or rods of the columnar layer of the retina being stopped and reflected by the choroid can only return by again permeating the same sensitive structure, thus increasing the impression, without diminishing the clearness of the image. Thus in the normal eye the hexagonal cells lying behind the rods of Jacob, reflect back the light in a manner which may seem to render it useful. The confusion of vision of old people in whom the hexagonal cells are often destroyed, and also in albinos, may thus be accounted for.* But I have certainly seen instances in which the hexagonal cells alone have been almost completely destroyed, and yet the patient's vision has been remarkably good. It must not be supposed that the cases just referred to, of removal or distension of the epithelium of the elastic lamina without impairment of vision, are of common occurrence; they are, indeed, quite exceptional; for although this alteration does not appear directly to affect the functions of the retina, yet in the majority of instances it is the result of some pre-existing disease, which has also produced defective sight.

Loss of epithelium with other disease.

Colloid Disease.

Colloid Disease.—A very peculiar disease of this membrane has been described as colloid degeneration of the elastic lamina. The tissue becomes thickened in certain spots, small wart-like projections forming on its inner surface, which may be sufficiently numerous to render the elastic lamina rough and uneven, and cause absorption of the hexagonal epithelium. These changes are rarely met with except in very old people, a few instances only having been recorded in which younger persons have suffered from the disease; and as old people are apt to suppose the dimness of vision which they experience to be simply the result of advancing years, they do not think it necessary to consult a surgeon on the subject, more especially as

Confined to old people

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* "Dobell's Report on Progress of Medicine for 1870" p. 13.

But seldom seen.

the affection occasions them no pain. Colloid degeneration, therefore, seldom comes under our notice until a late period; but even if this were not the case, it would be out of our power to trace with the ophthalmoscope the changes taking place in the elastic lamina in its early stages, among dark-skinned races; so soon, however, as the disease has advanced a little, we might possibly recognise the uneven condition of the elastic lamina.

Terminates in calcareous degeneration,

In the last stage of this affection, the projections on the elastic lamina become calcified, and ultimately earthy matter is deposited in them, so that they effervesce on the application of a strong acid, and when cut, the edge of the knife grates against them in an unmistakeable manner. As these changes advance, the lamina of course becomes opaque, and the vessels of the choroid, which in the early stages of the disease were exposed by the destruction of the hexagonal cells, gradually become indistinct, and are ultimately entirely hidden from view. Earthy matter is deposited in the walls of the vessels, as well as in the elastic lamina, so that atrophy of the choroid ensues.

and atrophy of choroid.

DISEASES OF THE OPTIC NERVE.

VENOUS CONGESTION.

Mechanical.

Retinal veins pulsate.

VENOUS CONGESTION of the vessels of the papilla. This condition of the vessels of the papilla is often well marked in certain affections of the heart (disease of the aortic valves); it also arises from other causes which interfere with the circulation, as, for instance, tumours situated at the base of the brain. Under these circumstances we notice a marked pulsation of the central vein of the retina, which is generally tortuous and much engorged, and the papilla presents a deep venous tint. Long-continued hyperæmia of this kind, by interfering with the nutrition of the nervous matter of the papilla, may lead to fatty degeneration and atrophy, as already described in the case of similar affections of the retina. The hyperæmia, on the other hand, may be of a transient nature, depending on sympathetic irritation, or some such cause, and may pass away without inflicting any injury on the nervous tissue of the optic disc.

May cause fatty degeneration.

Transient congestion.

Probably the most frequent causes of venous hyperæmia of the papilla are the various affections of the

Congestion from intra-ocular tension.

eye which induce increased intra-ocular tension, and thereby abnormal pressure upon the veins in their exit from the eye; as, for instance, glaucoma. The venous hyperæmia in these instances, as in most other cases, being due to mechanical causes, it is to these we must turn our attention with a view to their correction or removal; in some instances, it may be, by controlling the action of the heart by appropriate means, and in others by relieving the tension of the eye by iridectomy, we shall effect our object.

Treatment.

CAPILLARY HYPERÆMIA.

HYPERÆMIA OF THE OPTIC PAPILLA.*—The state of the vessels of the optic nerve is often an index of the condition of the cerebral circulation in consequence of their intra-cranial origin; but they may be only slightly congested, or, on the other hand, white atrophy may have commenced, without our being able to appreciate these changes, in consequence of our having no absolute standard of health with which to compare the appearances presented, and so to estimate the amount of disorder which is present in the circulation of the papilla at any particular period. We may, however, rest assured that, so long as the patient has no symptoms of cerebral disease, haziness of vision, or other defects of sight—in fact, as long as his eyes are emmetropic and his brain free of all suspicion of disease, any supposed changes we observe in the papilla are of small importance. On the other hand, if defect of sight is complained of, and we can discover no fault in the accommodation of the eye, or in the dioptric media, but the optic papilla appears to be congested, or paler than usual, we shall have to inquire carefully into the concomitant circumstances of the case, and the alteration in the state of the papilla will probably give us a valuable clue as to the cause of the imperfection of vision. We should further compare the state of one eye with that of the other; differences in this respect may materially assist us in forming a diagnosis.†

Difficult to appreciate.

Unimportant if vision is perfect.

Otherwise examine carefully.

Symptoms.—In cases of well-marked hyperæmia of the vessels of the optic papilla, the disc assumes a deep rose colour, and its circumference is no longer

Disc of a rose colour.

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* "Altérations du Nerf Optique," par X. Galezowski, p. 54.

† "On the Use of the Ophthalmoscope in Diseases of the Nervous System." By T. C. Allbutt, M.D., London, 1871, p. 47

clearly defined as in health, the vessels of the retina being more or less congested; in fact, we may be able to discern nothing of the papilla beyond its centre, the rest of the fundus of the eye being of a uniform scarlet or brick-red colour. In some instances of capillary hyperæmia, one or more of the vessels of the disc give way, and minute spots of ecchymosis are then observed over the surface of the congested papilla.

Margin not defined.

Ecchymosis.

A patient suffering from capillary hyperæmia of the papilla usually complains of a sense of weight and weariness in the eyes; this feeling is increased after work. He generally also suffers from headaches, especially if he over-exerts his sight; and at these times he notices flashes of light, and bright balls or sparks of fire before his eyes. If the disease is allowed to advance unchecked, the functions of the eye become more impaired; the patient can no longer see to read small type, and ultimately atrophy may occur, and the sight be hopelessly destroyed. So severe a termination as this, however, is not likely to follow, unless the congestion is absolute and long continued, and probably depending upon some affection of the brain or its membranes.

Sense of weight.

Headache.

Flashes of light.

Atrophy may follow.

Causes.—In many cases the hyperæmia may be functional, and due to causes of a sympathetic nature; and the congestion of the vessels of the papilla may be overcome by attacking the remote cause of the disease, whether it exists in the alimentary canal or other part of the body. I need hardly remark that engorgement of the vessels of the optic nerve, serous affusion into its substance, and in fact hyperæmia of the structures involved, may exist and lead to loss of sight, without any inflammation having occurred in the parts concerned.

Causes.

Sympathetic irritation.

Among the more direct but temporary causes of hyperæmia of the papilla, I may mention alcohol and quinine;* both of these substances, if used in excess, produce a very marked degree of hyperæmia of the papilla, and if swallowed in too large and too frequent doses, may actually induce serious changes in the

Alcohol and quinine.

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* Case in point, reported by Dr. P. Franks: "Army Medical Department, Statistical Sanitary and Medical Report for 1860," p. 417.

nervous substance of the part: in the majority of cases these changes take place slowly: loss of sight, and the other symptoms above described, creep on gradually, and warn the patient and the surgeon of the impending danger; and if the cause of the hyperæmia is then removed, the papilla usually regains its normal functions and the sight is restored.

Both papillæ involved,

In these and similar affections in which the entire circulation of the brain is disturbed, both papillæ are involved; in fact we seldom meet with unilateral hyperæmia of the papilla unless the cause of the congestion is intra-ocular. In some rare cases of orbital tumours, embolism of the central vessels of the retina, and the like, the circulation in one eye only may be impaired; but these are exceptions to the rule that unilateral affections of the papilla are due to intra-ocular causes. Such causes we find in glaucoma, irido-choroiditis, choroido-retinitis, inflammation of the retina, and so on; but in all these instances we shall have other indications of the presence or pre-existence of these affections, and unequivocal evidence as to the cause of the alterations in the circulation of the papilla.

unless the cause be intra-ocular.

Hyperæmia from sun-glare.

It is not an uncommon thing to meet with people in India, suffering from headaches induced by over-exposure to the sun; the papilla will often be found intensely congested under these circumstances, the capillaries of the retina being somewhat hyperæmic also. The glare of the tropical sun appears to over-stimulate the retina, and it becomes congested and swollen; if the exciting cause continues in operation, the irritation is propagated to the brain, and headache and irritative fever ensue. It seems to me that irritation, under these circumstances, commences in the retina, because I have frequently found in my own case, that a pair of coloured glasses has saved me when exposed to a tropical sun, from the distress produced by the glare, and subsequent headache, which one so frequently experiences unless the eyes are thus guarded. There can be little doubt as to the necessity of protecting one's head from the rays of the sun, but it is almost as important to shade the eyes from its glare. Nature appears to some extent to have made a provision of the kind for the natives; the colouring matter contained in the pigment cells of the iris, choroid, and cells of the elastic lamina, absorbing the excess of light which enters the eye.

Treatment

The Treatment of capillary hyperæmia of the optic nerve must depend entirely upon the cause of the congestion. I have endeavoured to describe the principal circumstances which give rise to this affection of the papilla, and it would entail a repetition of much that has been said, were I to attempt to discuss the treatment appropriate to each class of cases. Provided we can arrive at a definite conclusion as to the cause of the disease, we must then direct our treatment mainly upon general principles, adopting in certain instances such special measures as have been indicated in the foregoing pages, and which the particular circumstances of the case may seem to require. Among these I cannot but hope that a more systematic use of the electro-magnetic current may yet prove to be a valuable method of controlling the capillary circulation in this situation.

to be carried out on general principles.

Anæmia of the Disc and Retina.—This condition of the optic nerve, as Dr. Allbutt justly remarks, is generally accompanied with anæmia of the retina and choroid, so that the anæmic eye lights up badly; while in atrophy of the disc the choroid may be of healthy brightness. In anæmia as a rule the disc appears soft if not œdematous, however small the amount of blood flowing through the vessels we can distinguish the arteries from the veins, "which distinction in atrophy is most commonly lost."* In anæmia the symptoms complained of by the patient, his appearance and so on, lead us in addition to the state of the disc, as observed with the ophthalmoscope, to diagnose the nature of the disease from which he is suffering: and to prescribe treatment necessary for his recovery.

APOPLEXY OF THE PAPILLA.

From mechanical causes.

APOPLEXY OF THE OPTIC NERVE is seldom met with unless the retina is also implicated, and in many of these cases the origin of the affection is in the brain, or else in the heart. We also meet with apoplexy of the retina and optic disc, in various forms of disease entailing changes in the constituents of the blood—as for instance in Bright's disease, and from the effects of

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* Dr. C. T. Allbutt, "On the Use of the Ophthalmoscope," p. 51.

In Bright's and other blood diseases.

malaria; but in these cases the pathological changes in the retina are peculiar, and have been already described (p. 402). We shall observe the characteristic patches of fatty degeneration in the fundus in addition to the hæmorrhagic spots. In other cases, of which the following is an instance, it is most difficult to assign a cause for the extravasation of blood:—

Case.

No obvious cause.

Case.—Brohmo, aged twenty-five. This woman's sight was perfectly good up to within twenty days of her coming under observation, when, on arising in the morning, she felt heaviness of the head and slight pain in the temple and forehead, which has continued; her sight, from the commencement of this attack, has been growing dim. She has never had syphilis; her general health is good, and the menstrual functions regular.

At present the patient can only distinguish light from darkness; the tension and external appearance of the eyes are healthy; she has no disease of the heart. With the ophthalmoscope both eyes present much the same appearance: the arteries of the retina are contracted, its veins much distended, and the optic papilla almost completely covered with clots of blood.

Quick recovery.

Five days after admission the blood was gradually becoming absorbed, and in fifteen days no evidence of it existed. With the absorption of the clots the patient's sight returned, and she left the hospital within three weeks; she could then count No. II. dots at ordinary distance.

Usually depends on blood disease;

Or of the brain or heart;

Then persistent.

In the majority of instances of apoplexy of the papilla, as already stated, we shall have evidence of disease either of the kidneys, liver, or some of the secreting organs, affecting the composition of the blood; or else of organic disease of the heart or brain. In the case of heart affections the stethoscope will be our guide; and in diseases of the brain, in addition to the general derangement of the system accompanying lesions of this organ, we shall commonly find that the hæmorrhage has occurred suddenly, and in both eyes, and that the effused blood is confined to the optic disc or its immediate neighbourhood. Successive ruptures of the vessels are likely to occur in these cases, from the persistent and increasing obstruction to the circulation of blood through the retinal vessels.

Prognosis affected by extent of hæmorrhage.

In extensive hæmorrhage from the vessels of the retina, our diagnosis may be embarrassed by the effused blood having found its way into the vitreous and so preventing us from observing the changes going on in the fundus of the eye. In such instances we shall have too much reason to expect that detachment of the retina, to a greater or less extent, has also taken place. In less severe hæmorrhage our opinion of the case will be much influenced by the position of the effused blood: if at or near the macula lutea, the sight will in all probability be considerably affected, whereas hæmorrhage confined to the optic papilla may occur, and the blood become absorbed, without being followed by any bad effects. In forming a prognosis we must carefully consider all the bearings of the case, and the concomitant symptoms: if they should lead us to the opinion that irrecoverable lesion of the heart, brain, or kidneys is the cause of hæmorrhage, we can hardly expect amelioration of the symptoms as regards the organ of vision, or if amendment does take place that it will amount to more than temporary improvement.

Position of clot,

and the remote cause.

OPTIC NEURITIS.

INFLAMMATION OF THE OPTIC NERVE.—OPTIC NEURITIS.—The phenomena of optic neuritis vary with the origin and progress of the disease. For instance, if the inflammation of the nerve should depend upon irritation set up in the chiasma (descending neuritis), by the pressure of a tumour growing from the base of the brain, we should expect to meet with symptoms pointing to disease of the brain in addition to those characteristic of optic neuritis: but on the other hand, if the inflammation is confined to the optic nerve, no marked symptoms referrible to the brain will be present. Lastly, optic neuritis occurring as a complication of choroido-retinitis (ascending neuritis), will be characterized by appearances in those structures such as I have already described. In instances of this description one eye only may be involved, whereas in brain affections the neuritis, as a general rule, will be present in both papillæ. But it matters not if the neuritis is an ascending or descending one, the changes that take place in the optic disc and nerves are the same,—neo-plastic formations occur in, and around, the walls of the vessels, and the sheath and neuri-

Often complicated with brain symptoms;

And choroido-retinitis.

lemma of the nerve; from these combined causes, the nutrition of the nerve elements are impeded, and run a very great risk of being destroyed, hence atrophy of the optic disc is a common result of neglected neuritis of the optic nerve.

Symptoms.—In optic neuritis the symptoms complained of usually come on suddenly; a man may have had perfect sight in the affected eye, and in twelve or thirty-six hours his vision becomes dim, and in a few days sight may be hopelessly destroyed. During this period, and subsequently, the patient often complains of flashes of light and sparks of fire before his eyes, and frequently suffers severe pain in the head and some intolerance of light. The eye looks healthy, and the conjunctiva and sclerotic are normal, the pupil is usually somewhat dilated, and responds but slowly, if at all, to the stimulus of light. In other cases of a more obscure nature, especially if depending on malaria, or blood poisoning, the neuritis runs a very insidious course, gradual loss of sight being the only symptom complained of: cases of this description have probably been the cause of amaurosis, described as atrophy of the disc, arising from excessive tobacco smoking.

Sudden failure of sight.

Flashes of light.

Pain.

Pupils dilated.

Ophthalmoscopic Appearances.—On examining the eye with the ophthalmoscope during the early stages of neuritis, the optic papilla appears to be larger than in health, and in place of being concave, is distinctly convex, being swollen and œdematous from the effusion of serum that has taken place into it. In addition to this enlarged and convex state of the papilla, the disc can no longer be clearly defined; the infiltration structure throws a veil over the disc, particularly at its circumference, which presents an appearance as if covered over with a thin layer of cotton wool. This hazy state of the papilla extends only a short distance beyond its margin. (*Vide* Fig. 1, Plate VI.) The retinal vessels may be traced from their periphery towards the inflamed papilla, but on reaching the swollen disc they are lost in its substance, and cannot therefore be followed up to their exit from the eye. The retinal veins are engorged and the arteries contracted, and often hardly recognisable; these changes being due to the pressure exerted on the vessels by the swollen condition of the optic

Papilla swollen.

Margin woolly.

Veins engorged. Arteries contracted.

nerve, through which they have to pass in entering and leaving the eye.

Optic neuritis from tumours.

In some instances of optic neuritis (descending neuritis), depending on a tumour compressing the vessels at the base of the brain, the smaller vessels of the papilla become so deeply engorged, that they can be distinctly seen in the substance of the woolly-like papilla, radiating from the centre towards the circumference of the disc. I have seen this appearance well marked in cases of insolation.

From insolation.

Extravasation of blood from the distended vessels of the papilla is by no means an uncommon complication of optic neuritis.

Vision not always affected in proportion to the optic disc.

The above are the symptoms generally present in cases of optic neuritis; but it must be distinctly understood that the impairment of vision does not always correspond with the apparent alterations noticed in the disc, and on the other hand the sight may remain good, although with the ophthalmoscope well marked symptoms of optic neuritis are present. Cases of this latter kind, as Dr. Hughlings Jackson has remarked, seldom come under the care of the surgeon, but rather of the physician, in his treatment of cerebral affections.

Varieties of optic neuritis; Malarial.

We occasionally meet with cases of optic neuritis following constitutional diseases, especially malarious fevers, in which, with gradual cloudiness of the field of vision lasting for a few days, followed by total loss of sight, the optic disc is apparently only slightly affected: it is hazy from œdema, but the cloud seems a very fine one. In these cases the pupil is widely dilated, probably from irritation of the fibres of the sympathetic, and in several cases that have come under my observation the patient has evidently been under the influence of malarial poison, the neuritis clearing away under the influence of quinine.*

Plumbic neuritis.

Mr. Jonathan Hutchinson has drawn special attention to the fact that patients labouring under the influence of lead poisoning, occasionally suffer from optic neuritis. He remarks that, "Amongst the peculiar ophthalmoscopic features of plumbic neuritis we may mention (*a*) the small amount of lymph usually present; (*b*) the absence of colour in the lymph; (*c*) the absence (not invariable) of extravasation of blood; and

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* *Indian Medical Gazette*, 1870.

(*d*) the early and great diminution in size of the arteria and vena centralis. The choroid does not appear to be in the least implicated." These cases of plumbic neuritis would appear generally to lead to complete blindness.*

Another form.

In another class of cases the optic neuritis commences with hyperæmia of the disc and retina, followed by partial haziness of the disc, extending some little distance over the retina, and in this hazy portion of the disc and retina minute extravasations of blood will be seen, with fine grey striæ. The disc, or rather the outer part of it, as a general rule, becomes pale and atrophied, the inner half retaining its normal appearance.

In these cases the appreciation of colours is always more or less impaired; the disease usually advances slowly, and sight is seldom destroyed.

Causes.

Causes.—The causes of optic neuritis are numerous; among them may be mentioned tumours of various kinds, or inflammatory products pressing upon and interfering with the circulation of blood in the optic nerve or tracts. These obstructions, by mechanically inducing congestion of the vessels (veins) of the papilla, bring about serous effusion and optic neuritis. From experiments made by Dr. Schmidt, of Berlin, it appears that fluid can be injected from the arachnoid cavity between the inner and outer sheath of the optic nerve, and so to the lamina cribrosa, so that a direct communication exists, according to this author, between the arachnoid cavity and the network of the lamina cribrosa by which pressure of fluid may be conveyed, and in consequence the head of the nerve suffer strangulation, while the rest of the nerve trunk may be unaffected. An affection of the papilla of the nature above described may in fact be produced by "coarse" disease of almost any part of the cerebrum or cerebellum; it has been observed in meningitis and arachnitis, also complicating various forms of malarious fever, lead-poisoning, syphilis, and in cases of insolation, and over-exposure to the glare of a tropical sun. Lastly, it not unfrequently occurs in cases of retinitis and choroido-retinitis.

Dr. Schmidt's experiments.

Prognosis.—The prognosis in cases of inflammation

Ophthalmic Hospital Reports, vol. vii. p. 6.

Prognosis unsatisfactory.

of the optic nerve is on the whole unsatisfactory, especially if we have reason to suppose that the disease is complicated with some affection of the brain. Galezowski states that as many as twenty cases in one hundred recover, but my experience leads me to form a less favourable idea of the results of the disease than this, unless among the class of cases depending on malarious and syphilitic poisoning: in the former, we see many patients suffering from extensive optic neuritis, who nevertheless perfectly recover their sight. Excluding instances of this description, and those traceable to syphilis, my opinion leads me to form an unfavourable prognosis, for the majority of instances of optic neuritis terminate in atrophy of the papilla: the woolly appearance of the disc gradually clears away, but it is left with a jagged irregular circumference, generally with patches of black pigment adhering to it (Fig. 2, Plate VI.); and the papilla itself becomes white and flat, though it seldom has the pearly whiteness of primary or progressive atrophy. The central arteries and veins of the retina are much contracted, and in many cases dwindle away to fine streaks, extending only a short distance beyond the circumference of the disc. After death, the papilla and optic nerve have been found extensively degenerated, and, in some cases, in a fluid or pulpy state; this condition seldom passes beyond the chiasma.*

Often terminates in atrophy.

Treatment

Treatment.—The treatment of optic neuritis, if arising from syphilis, resolves itself into the ordinary specific and general treatment of that disease; the mercurial vapour bath, cod-liver oil, iodide of iron, and so on. In certain cases depending on malarious influences, quinine in moderate doses, or arsenic and iron with strychnine, will be required. Rest and counter-irritation are always useful in cases of neuritis. I fear, however, that in many instances that come under our care, we shall fail to stop the progress of the disease, and that in spite of all our efforts atrophy of the papilla will result.

CASE.

CASE.—The following history affords a good illustration of that variety of the disease to which I have referred, as occurring in the subjects of malarious poisoning:—

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* "Augenheilkunde," von K. Stellwag von Carion, p. 263.

Thako, aged thirteen, a resident of Chandernagore, was admitted into the Calcutta Ophthalmic Hospital January 24th. On November 9th she was attacked with quotidian intermittent fever, to which she had been subject for some years past, as well as to enlargement of the spleen. The ague continued for a week, and then disappeared under the influence of such simple remedies as she had been accustomed to employ under similar circumstances. Immediately after the fever had left her, numbness and inability to move the right arm and leg came on: the left leg on the following day was affected in the same way, so that she entirely lost the use of the lower extremities, without the existence of tingling pain or other abnormal sensations in the limbs to mark the advent or progress of the disease. As the paralysis increased she experienced advancing dimness of vision. The patient has never suffered from either hysterical or other fits. There is no evidence of her having been affected by inherited or acquired syphilis. She has never been salivated.

History of Ague.

Paralysis and loss of sight.

At the time of her admission into Hospital, on January 24th, she had completely lost voluntary power over the lower extremities and the right arm. The sensation in these limbs, though blunted, was not destroyed; marked reflex action existed in the legs; the muscles of the affected limbs were flaccid, and hung down precisely as though they had belonged to a dead body. The patient possessed feeble though decided voluntary power over the left arm. Her pupils were dilated and insensible to light, and she was almost completely blind, being only able to recognise the existence of a bright light held before her face in a dark room.

State on admission.

On examining the eyes with the ophthalmoscope we found the optic papilla swollen and hazy (woolly); evidently a considerable amount of serous effusion had taken place into its nervous structure, and also into that of the retina immediately surrounding the papilla; but with the exception of this œdematous state of the parts, the fundus of each eye was perfectly healthy. There was an entire absence of all other symptoms of optic neuritis or inflammation of the retina. Her voice and mental faculties were unimpaired. There was no paralysis of the muscles of the face, of respi-

Ophthalmoscopic appearance.

ration, or, in fact, of any part of the body, with the exception of those above indicated, nor was there evidence of disease of the heart or kidneys; the spleen was enlarged; the catamenia had appeared, and, though scanty, were regular.

Treatment.

The patient was ordered a generous dietary, and a mixture containing strychnine, arsenic, and iodide of potassium. She continued this treatment throughout her stay in Hospital.

Recovery.

A week after admission some improvement had taken place in her condition, and, without going into details, it may be mentioned that she gradually regained the use of her limbs, her eyesight was restored, and she left the Hospital absolutely cured. Within five weeks of her admission she was able to run about the ward, and count No. 1 dots at ordinary distances; the haziness of the optic papilla had entirely cleared away, and the fundus of the eye was perfectly healthy.

Such cases common in India.

Pathology.

Remarks.—This is an example of a class of cases by no means of uncommon occurrence among the natives of India, and depending apparently upon miasmatic influences affecting alterations in the blood, and thereby inducing local hyperæmia and serous effusion into various organs. I repeatedly meet with cases of impaired vision arising from this cause, the hyperæmia being confined to the retina; its nervous structure becomes hazy and infiltrated with serum, and in some instances is detached from the choroid. The complete paralysis of the lower extremities and of the right arm, the left being unaffected, pointed to the existence of that rather anomalous group of symptoms described by Dr. Todd as hysterical paralysis, but the state of the eyes cleared up any doubt on this point. The symptoms presented by our patient at the time of her admission into Hospital pointed to serous effusion into the optic thalami and corpora striata similar to that noticed in the optic papilla, the pressure thus caused on these important nervous centres interfering with the volition of the patient over the affected limbs. The reflex action was only slightly impaired, and the patient had complete control over the bladder; the functions of respiration and deglutition were perfect, so that, as far as the trunk was concerned, she simply suffered from ina-

Serous effusion in the Brain and optic papilla.

bility to move some of her limbs, the centres of volition, but not the will, evidently being affected. The patient, however, was absolutely blind; the pupils were widely dilated, the functions of the retina being destroyed for the time being. The ophthalmoscope showed the cause of the loss of vision by revealing to us the existence of extensive serous effusion into the optic papilla and nervous matter of the retina immediately surrounding it, but there was no evidence whatever of hyperaction in the part; the circulation through the central artery and vein of the retina was unaffected; there was no hæmorrhage or indication of structure change in the part; so that one was able to form a favourable prognosis, not only as regards the recovery of vision, but also of the paralysis—the condition of the optic papilla, and the history of the case, leading us to conclude that the loss of voluntary power over the affected limbs must depend upon a similar cause to that which induced the loss of power in the retina, and hence to arrive at the conclusion above indicated as to the seat of the effusion in the brain.

The ophthalmoscope an aid to diagnosis.

ATROPHY OF THE OPTIC PAPILLA.—Cases of atrophy of the papilla may, for the sake of description, be conveniently divided into two classes—First, those in which the degeneration follows some inflammatory or other disease of the eye or optic nerve, and which may be called Consecutive Atrophy; and secondly, those in which the disease appears to be a primary affection—a degeneration beginning from within, not preceded by any active stage, and which may therefore be distinguished as Primary or Progressive Atrophy; in practice we shall meet with these forms of atrophy, often running one into the other.

ATROPHY OF THE PAPILLA.

1. *Consecutive Atrophy.*—This may follow various affections of the eye, optic nerve, or brain; most of these we have already considered.

1. Consecutive atrophy.

In the course of my remarks on optic neuritis, I observed that when atrophy of the papilla is a result of inflammation of the nerve, that the circumference of the papilla becomes irregular, and is often marked with patches of black pigment; that the disc itself assumes a white colour, and that the central artery and vein of the retina are usually very contracted in size: the vein may however be dilated and tortuous.

After neuritis.

or retinitis. Atrophy of the papilla resulting from pigmentary degeneration of the retina, or from affections of the retina due to syphilis, irido-choroiditis, and like affections, can with ease be diagnosed from atrophy such as that above described, for in addition to the appearances presented by atrophy of the disc, we shall have those indicating the nature of the affection, which has led to the degenerative changes in the optic nerve.

In glaucoma and post. staphyloma. Lastly, the atrophy which is noticed in cases of glaucoma, and posterior staphyloma, is generally marked by the cupped appearance of the disc, and an engorged state of the central vein of the retina.

2. Progressive atrophy. 2. *Primary Atrophy.*—But there is another form of atrophy of the papilla which we frequently meet with, and which is too often characteristic of affections producing intracranial irritation, "Progressive atrophy of the papilla,"* as it has been called. This form of atrophy may come on without head symptoms, but gradual loss of sight (amaurosis) occurs without any apparent cause. The patient may not suffer from pain or other head symptoms, but generally from flashes of light and sparks of fire before his eyes; the pupil is usually contracted and immovable, but in other respects the eye looks healthy. Colour-blindness is usually a well-marked symptom in these cases. Little by little the sight fades away, until vision is completely lost, and the unfortunate patient thus acquires the vacant gaze and wandering expression so characteristic of total blindness.

No head symptoms.

Flashes of light.

Gradual loss of sight.

Both eyes affected. On examining such an eye, or rather eyes, with the ophthalmoscope—for both eyes are usually affected—we shall discover that the optic disc is of a pearly white, circular, and flat; its circumference well defined and regular, and the central artery and vein of the retina of their normal size and appearance (Fig. 3, Pl. VI.) Clearly, in these cases, it is the optic papilla that is affected, and on examination it is found, that if the active symptoms which have led to these changes have passed away, that the optic disc is occupied by a fibrous structure, its nervous elements having very probably entirely disappeared.

Disc flat, round and white.

Causes. *Causes.*—It has been already observed that progressive atrophy of the papilla occurs principally in connexion with affections of the nervous centres, causing intracranial irritation; and when we remember that pathological changes in widely different parts of the hemispheres, and also of other portions of the nervous system, as the cerebellum and spinal cord, as well as tumours at the base of the skull, have all been demonstrated to give rise to progressive atrophy of the optic papilla, we may well look anxiously in these cases for symptoms of cerebral disease, or other grave nervous lesion. The causes of progressive atrophy of the papilla, with the exception of this fact of its association with disease affecting large portions of the nervous centre, are as yet ill defined, and it would be out of place to attempt to give more than a passing glance at the subject.

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* "Altérations du Nerf Optique," par X. Galezowski, p. 84.

Disease of nervous centre.

M. Galezowski states that progressive atrophy of the papilla, ending in amaurosis, is most common among men, as many as 70 per cent. of these cases occurring in males. He accounts for this by the excessive brain work which men have to undergo, and the free use they make of alcohol and tobacco. To mental labour and alcohol I am quite prepared to assign a place as causes of progressive atrophy, but I find it difficult to believe that tobacco-smoking alone can induce disease of the brain, or of the optic nerve, so as to cause progressive atrophy of the papilla;* in combination with alcohol, venereal excess, and free indulgence in other bad habits, it may lead to blindness; nevertheless, surgeons of great repute hold a different opinion on this subject, and consider that excessive smoking directly induces atrophy of the optic papilla.†

More common among men.

Alcohol.

Tobacco.

M. Galezowski further remarks, that the majority of instances of progressive atrophy of the disc are caused by atheromatous disease of the vessels of the base of the brain, and of the nerve itself. He observes, if the patient lose his sight from progressive atrophy, and we can trace the disease to no other cause, we may generally attribute it to atheromatous degeneration of the walls of the vessels.

Disease of blood-vessels.

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[*] See "Lecture on the Theory and Practice of the Ophthalmoscope." By H. Willson, F.R.C.S.; Dublin, 1868.

[†] Carter's Translation of Zander "On the Ophthalmoscope," p. 131.

Prognosis bad.

Prognosis is generally unfavourable, but we must not give up all cases as hopelessly bad, for instances are recorded in which, although symptoms of advanced atrophy were present, the patient has regained a fair amount of sight. We may have considerable difficulty in determining the nature of the disease in its early stages, as the disc gradually becomes atrophied, and until it is decidedly whiter than in health, we shall hardly be able to assure ourselves that the loss of colour, noticeable in the early stages of the affection, is not the result of a temporary cause; but our diagnosis will be aided if the patient complaining of gradual loss of sight, which is not improved by either convex or concave glasses, and by the absence of any other symptoms or appearances, accounting for the impairment of vision. If in addition flashes of light are noticed before the eyes, and we can detect a gradual whitening of the papilla, we must necessarily be very anxious as to the result of the case—in fact, in spite of all we can do, the patient will probably become amaurotic.

Early diagnosis difficult.

Treatment.

Treatment.—This will of course vary with the nature of the case; but as progressive atrophy of the papilla is generally associated with disease of the nervous centre, our remedial measures must be mainly directed to that important part. Unfortunately the treatment of cerebral diseases is at present unsatisfactory in the extreme; it would seem, however, that we may hope to influence some obscure affections of the brain by the electro-magnetic current, and we may reasonably expect that more extended researches will throw fresh light on this subject as time rolls on. In the meantime we should endeavour to counteract or remove the more remote causes of these affections: thus if our patient is the subject of a gouty or rheumatic diathesis, we may look to these conditions as connected with the changes going on in the brain. Syphilis, again, and malarious influences, no doubt often play an important part in producing disease of the nervous centre, and should always enter into our consideration in the treatment of this class of cases. By carefully investigating all these points in the history of the disease, we may be able to do something to stay its progress; and although our task may be almost a hopeless one,

Unsatisfactory.

Must be directed to remote causes.

yet we are bound to do all in our power to save our patient from blindness.

AMBLYOPIA AND AMAUROSIS, or partial and total loss of sight. I am bound to say a few words on this subject, before leaving the consideration of the diseases of the nervous apparatus of the eye; but I trust the foregoing part of this work has rendered the use of these terms almost unnecessary; that is to say, that we need seldom employ expressions so inclusive and vague at the present day, but be able, in almost every case, to assign a definite cause for the impairment or loss of vision, from which our patients may be suffering.

AMBLYOPIA AND AMAUROSIS.

Terms almost obsolete.

Dr. Bader classifies the causes of amblyopia and amaurosis under the following divisions:*—

Modern distribution of cases.

I. Ocular (retinal, choroidal, or in the optic nerve).
II. Extra-ocular (orbital).
III. Cerebral or spinal.

This classification certainly seems to meet all the circumstances of these cases.

Ocular cases.

Blindness, whether partial or complete, arising from any of the causes first mentioned, will be found discussed under the heads of disease of the retina, choroid, and optic nerve.

As an instance of the second class, I may refer to the remarks made upon inflammation of the cellular tissue of the orbit inducing atrophy of the optic nerve. Another instance of the kind is amaurosis following wounds and injuries of the supra-orbital nerve. Exophthalmos and its causes all come under this heading, as being either directly or indirectly the cause of amaurosis. Lastly, absolute or total blindness may be induced by intra-cranial tumours pressing on the optic tracts and vessels of the optic nerve, or from apoplexy, softening, or tubercular disease of the brain or its membranes, as well as by injuries involving the base of the brain.

Orbital.

Intra-cranial.

Amaurosis, or amblyopia, may occur, among other symptoms, in albuminuria, syphilis, diabetes, and embolism, and "during irregular menstruation, preg-

Symptomatic of various dyscrasiæ.

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* *Guy's Hospital Reports* vol. xii. p. 578.

nancy, parturition, or lactation." In the latter group of cases the affection is usually functional, and disappears after its exciting cause has been removed. After prolonged lactation, for instance, dimness of vision is often induced by anæmia of the retina, and can only be cured by giving up nursing and resorting to a tonic plan of treatment.

General considerations regarding amaurosis.

Without, however, entering at length into subjects already treated of in previous sections of this work, it seems desirable to make a few further remarks on partial loss of sight (amblyopia), and complete loss of sight (amaurosis).

State of visual field.

Centripetal contraction.

Fault begins on outer side of retina.

In attempting to appreciate the circumstances of the class of cases under consideration, we cannot place too much stress upon the importance of carefully ascertaining the condition of the field of vision; its periphery may be comparatively perfect, while the central portion of the visual field is incapable of appreciating the stimulus of light, or *vice versâ*. In either case, the retina and optic disc may appear, when examined by means of the ophthalmoscope, to be healthy, the impairment of vision being the main and prominent feature in the case. We should note with reference to the conditions of the visual field if this fault be simply an interruption only, as in scotoma; or if the impairment of vision extends from the periphery towards the axis of vision. Scotoma is far more likely to attract the patient's attention than the more insidious and dangerously progressive loss of sight, not unfrequently the precursor of amaurosis, due to loss of the sensitive power of the retina, and advancing from without towards the axis of vision. As a general rule, amblyopic contractions of the field of vision commence on the temporal side of the retina, sometimes on the nasal side, but never above or below the axis of vision; the contraction of the field advances from without inwards, so that ultimately the visual field is slit-shaped, the whole of its outer and inner parts being dark, that is, incapable of visual impressions. Hemiopic contractions of the visual field sometimes affect one-half of each retina only, either simultaneously or within a short time of each other, indicating disease of one root of the optic nerve; but in cases of this kind the lines of the visual field are so sharply defined in either eye, that they lead us at once to a probably accurate diagnosis of the nature of the defect complained of, and nature of the lesion upon which these symptoms depend.

State of pupil.

Unsteady movement of affected eye.

The condition of the pupil will naturally attract our attention in cases of amblyopia and amaurosis; immobility of the pupil is only found in complete amaurosis, or when paralysis of the ciliary system, or mechanical hindrances, render the movements of the iris impracticable. The unsteady and generally excessive movement of the amaurotic eye is also very characteristic.

Causes and Prognosis.

Mechanical causes.

Causes and Prognosis.—Amaurosis or amblyopia may arise from mechanical causes, as for instance from a blow on the eye separating the retina from its attachments, and rupturing one or more of the vessels, the hæmorrhagic effusion breaking down the delicate nervous structure of the retina. Similar results may of course follow hæmorrhage proceeding from the rupture of a diseased vessel. Loss of sight thus produced may improve, especially if the case is a recent one, and the optic disc appears healthy; but if the papilla indicates advancing atrophy, the prognosis is most unfavourable. Under this class of cases we may also place instances of embolia of the central artery of the retina.

From loss o blood.

Prognosis.

Impairment and loss of sight occurring after profuse hæmorrhage, whether from the uterus, stomach, or other organs of the body, if it comes on rapidly and is complete, is generally incurable. This form of amaurosis may sometimes, however, commence in a gradual failure of the acuteness of vision in the whole visual field, generally with lateral limitations, at first, perhaps, disappearing for a time, returning, however, too surely, and terminating as above indicated. It may happen that we can discover nothing abnormal with the ophthalmoscope; nevertheless we cannot hold out hopes of recovery to the patient, as some would suppose, with a return of the normal blood supply.

The same remarks are applicable to instances of complete loss of sight following over-suckling. In these instances it is more than probable that the nutrition of the nerve elements of the retina having been impaired, these delicate structures have undergone irreparable changes leading to loss of vision.

In pregnancy.

I have seen two cases of amblyopia coming on during pregnancy, without any appreciable cause, and very similar to the instance related by Mr. Lawson.* In these cases, however, I detected slight effusion over the optic disc; the loss of sight was gradual from the seventh month to the time of delivery, and did not subsequently improve. In cases of amblyopia coming on during gestation, although the ophthalmoscope may not demonstrate any marked disease, I should be inclined to give a very cautious prognosis.

In diabetes.

In this class of cases we must also place amaurosis met with from time to time among diabetic patients, although it is very probable the impairment of sight is in the first instance due to paralysis of the accommodation. Amaurosis in cases of severe lead poisoning is attributable to a like cause. (P. 442.) In all these affections improvement of sight may from time to time occur; atrophy of the papilla, however, too surely follows, sooner or later, and with it total blindness.

From lead.

From toxhæmia in general.

Another form of amaurosis is that which depends on blood poisoning, as it is called, but which we may in the present state of our knowledge better describe as Stellwag does, as originating from the action on the brain of certain morbid or foreign materials in the blood. It is by no means clear if these foreign materials affect the optic nerve and retina directly, as atropine does the ciliary nerves, or if the loss of vision is due to secondary conditions, brought about by organic changes, chiefly of a proliferative kind, and terminating in white atrophy of the optic disc.† Among the most important of this class of cases may be mentioned uræmic amaurosis, that from lead poisoning, from opium, tobacco, the over-use of mydriatics, nux vomica, and quinine, and alcohol.

Alcoholic amblyopia.

With reference to the influence of alcoholism on the sight, M. Galezowski remarks, that amblyopia from this cause is only met with among men. I agree with him that the following are the characteristic symptoms of this form of blindness:—1. The patients perceive that their sight has become somewhat suddenly enfeebled, but it then remains in a stationary condition for several weeks. 2. The acuteness of vision is sensibly dimi-

Sight impaired.

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* *Ophthalmic Hospital Reports*, vol. iv. p. 66.

† Stellwag von Carion, "Diseases of the Eye." By Hackley and Roosa, p. 668.

nished, the patients being scarcely able to read the characters 8 or 10 of the author's typographical scale; while in some cases they cannot distinguish even the largest, as No. 50. 3. Distant vision is much diminished, the face of a person not being recognisable at some paces distance. A sort of white haze seems to envelope every object. 4. A kind of nyctalopia accompanies this form of amblyopia, the patients seeing more distinctly as the evening approaches; the haze then being less apparent. 5. The perversion of the chromatic faculty is not less characteristic. Carmine, red, and green are often confounded with each other; violet is taken for red, and yellow for red. . . . . . . 6. These patients frequently see double or triple, probably on account of spasmodic contractions of the muscles of the eye. A waiter at a *café* lost his situation because as he saw every cup double, he poured the coffee on the outside of it. . . . . 7. The amblyopia is very frequently accompanied by visual hallucinations, which are, however, rather due to a cerebral than an ocular affection. 8. The pupils are not alike in the two eyes, one being generally larger than the other, and often irregular. No other alteration is observed in the exterior of the eyes. Ophthalmoscopic examination, as a general rule, only furnishes negative results, the papilla of the optic nerve remaining of its normal colour. In some cases, however, there may be observed a kind of serous suffusion, especially in the vicinity of the vessels. The arteries in some places exhibit spasmodic contractions, while the veins are tortuous and gorged. This disposition is observed to be more marked as the disease becomes prolonged, and then the papilla of the optic nerve is pale and whitened, without, however, exhibiting that pearly whiteness which is met with in progressive atrophy of the papilla.

Day and colour blindness.

Double vision.

Ocular spectra.

Ophthalmoscopic signs.

Diagnosis

The differential diagnosis of the disease need not be insisted upon after the above statement of symptoms, which proves that alcoholic amblyopia is an affection of the eye apart, which can only be simulated by commencing atrophy of the papilla. But any doubts that may be entertained become dissipated in the subsequent course of the affection; for, while the atrophy advances progressively, the amblyopia remains stationary for weeks or months. It may even be completely cured, to return again after renewed excesses in drinking.

Pathology.

With respect to the pathology of this form of amblyopia, M. Galezowski says that "it is due to a kind of paresis of the longitudinal muscular fibres of the arteries, which act in dilating them, and to a spasmodic contraction of the circular fibres of these same vessels. The blood does not arrive in a sufficient quantity for the arteries, while the veins undergo a kind of passive stasis." In conformity with this view, a collyrium of éserine or calabarine has been employed as a means of inducing relaxation of the spasmodic contraction of the arteries. The efficacy of this agent is incontestable, for the patients are immediately relieved, seeing better during the whole period that its action continues, while its daily use leads to a sensible amelioration. In many of the cases large doses of bromide of potassium have produced sensible amelioration, confirming M. Gübler's good opinion of that medicine in the treatment of alcoholism in general.*

Treatment.

Summary.

To sum up:—1. The disease appears as a consequence of prolonged indulgence in alcoholic drinks, and especially when these are taken fasting or before dinner. 2. Bad food and a wretched condition of existence predispose to its development. 3. Complete abstinence from alcoholic drinks during several weeks or months is an indispensable condition for recovery. 4. The bromide of potassium is a very efficacious remedy: and the éserine collyrium is one of the best means of combating the visual disturbance. 5. This amblyopia is tractable when combated at an early period; but later it becomes a serious affection, which is very difficult of cure.

Amaurosis in fevers.

In another class of cases of amaurosis, arising apparently from alterations in the condition of the blood, the blindness may be only temporary, such for instance as partial or complete loss of sight after an attack of typhus fever, or scarlet fever. The blindness usually comes on suddenly, lasting for two or three days, and then returning. But it is remarkable that in many of these instances the pupil responds to the stimulus of light; and this is a significant point

State of the pupil.

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* *Medical Times and Gazette*, 1871, vol. i. p. 520.

as a guide to prognosis, for if the pupil retains its activity, however great the blindness may be, we may, in the above mentioned cases, offer a favourable prognosis, for the facts indicate that whatever the cause of the loss of sight, it must be situated between the corpora quadrigemina and that portion of the brain in which the perception of light is localized.

Colour-blindness in relation to Amblyopia.

The ability to discern colours is injured in various affections of the eye, and has been a matter of attention by many observers, but we yet do not possess exact information on its relation either to the healthy or morbid states of the organ of sight. The most common cases in which this defect appears are those of atrophy of the optic nerve. Dr. Leber has investigated thirty-six cases of this kind, all of which had amblyopia and limitation of the visual field, and in all but three there were anomalies in the perception of colour. This defect occurs under every form of nerve-atrophy, the simple, the inflammatory, and the glaucomatous, as well as in every degree of amblyopia. Even where sight is not much injured, colour-blindness may be very marked. The prognosis of the nerve-affection is not modified for better or for worse, by the loss of colour-perception. The colour to which patients are most frequently insensitive is red, while blue is best preserved: green appears yellowish or grey; rose and violet, bluish; yellow commonly appears yellow. In the later stages of the malady only the bluish shades are apt to be recognised, all others appearing whitish, grey, or dark. This corresponds closely with what is true of the normal eye during deep twilight.

Leber's Researches.

In three cases of *hemiopia* there was no defect of colour-perception in the sound half of the field. In one of these cases vision was nearly restored, but on the blinded side the colour-sense remained defective. Quaglino and Boys de Loury published each a case of hemiopia in which there was absolute colour-blindness for the remaining field.

In hemiopia.

An extremely interesting class of cases are those of amblyopia and central scotoma without ophthalmoscopic lesions. The amblyopia occurs without central scotoma; and in these cases there is little derangement of the perception of colour. Out of twenty-one cases of amblyopia without scotoma, only three were

Rare in amblyopia without central scotoma.

unable to distinguish red. These patients acquire their amblyopia from abuse of alcohol, tobacco, and other toxic substances, a few from anæmia and malnutrition. This assertion appears to be supported by the fact that, out of eighty-one cases of amblyopia, in which there were no ophthalmoscopic lesions and no central scotoma, there were seventy-five men and six women.

Constant with central scotoma.

But cases of amblyopia without visible lesion, but with central scotoma, present marked impairment of sense of colour. At an early stage of these cases is to be found sometimes a faint, striated haziness of the border of the papilla and neighbouring retina, which resembles syphilitic retinitis, but, unlike the latter, extends only a little distance into the retina. Twice there were evidences of diffused retinitis; in several cases there were isolated hæmorrhages; but generally no changes could be seen by the ophthalmoscope. At a later period the papilla is apt to show alteration of tissue in pallor or slight bluishness of its outer half—a sign of partial atrophy at least in some of the cases. Of this class of cases fifty-six were seen, and in thirty-one the perception of colour tested; of which in all there was a discernible impairment. So uniform was this fact that it may be taken as a means of diagnosis of the existence of central scotoma.

Central scotoma a disease of men;

Central scotoma generally affects both eyes, though to unequal degrees, and simultaneously. It is a disease of men almost exclusively. It affects those above twenty years of age, and increases in frequency to forty years. Abuse of alcoholic drink and of tobacco-smoking are often assigned as causes, while exposure to cold and wet also have a part. In some cases syphilis is the probable cause.

Mostly a form of optic neuritis.

There are reasons for believing that the seat of central scotoma is often not situated in the retina, nor the brain, but in the trunk of the optic nerve between the chiasm and the globe, and is the result of neuritis. There are anatomical and pathological reasons for the assertion that the fibres which go to the rods and cones at the macula lutea are situated on the superficial parts of the nerve-trunk, and those which belong to the periphery lie nearer to the centre of the nerve. A perineuritis would, there, explain the symptom of central scotoma.

Prognosis and Treatment.

The results of treatment are always much less favourable in amblyopia with central scotoma, than in amblyopia without scotoma. If the colour-blindness reach to the periphery of the field, and the nerve show manifest signs of atrophy, treatment will be almost fruitless. The therapeutics must be suited to the state of the individual, but in general they are blood-letting, sudorifics, purgatives, and tonics. In some cases iodide of potassium in small doses has proved of unexpected value after other things had been tried in vain.*

Amaurosis from local hyperæmia.

In heart disease.

In considering the subject of diseases of the retina and optic nerves, I have mentioned my conviction as to hyperæmia of the vessels of these structures not unfrequently leading to degenerative changes in the nerve elements of the retina ending in amaurosis. It is probable that under these circumstances not only does increased proliferation take place in the connective corpuscles, but the serous exudation arising from blood stasis is apt to damage the delicate structures among which it is infiltrated. For similar reasons we may meet with an undoubted congestive form of amaurosis consequent on a too powerful action of the heart, and which may disappear when the disturbance in the circulation has subsided. Intracranial overloading of the blood-vessels may lead to a similar result, and will be accompanied by symptoms of cerebral hyperæmia; the loss of sight is often very sudden, and may as rapidly recede on the removal of the exciting cause; among such causes may be mentioned, interruption of the menses, mental excitement, excessive vomiting, or muscular exertion.

Ophthalmoscopic signs:

Impairment of sight, depending on disease of the heart, is by no means of frequent occurrence; when it does take place it is attended by the following alterations:—

Congestion.

1. *Capillary congestions of the retina and venous varicosities.*—Sometimes there are venous stases in the retina, but their progress is slow and gradual, so that vision is in no way troubled. It is only in exceptional cases that the venous congestion occasions disorders of vision either constant or periodical; but then we have

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* "Colour-blindness," by Dr. Leber; *vide* "Report on Progress of Ophthalmology for 1870," G. H. D. Noyes, M.D., *New York Medical Journal*, Feb. 1871, p. 209.

no longer simple varices in the principal branches, but capillary congestions of the retina more or less marked.

The venous stases of the retina are to be sought for especially in the capillary branches. An ophthalmoscopic examination with inverted images is not sufficient to make out this capillary stasis; we must have an erect image and a strong magnifying power.

Extravasation.

2. *Extravasation of blood into the retina and optic nerves.*—In heart disease effusions into the retina are the most common of all alterations. They take place both from the over-powerful impulse of a hypertrophied heart, or, what is more common, from the insufficient impulse of the same organ when enfeebled. The rupture of the capillaries is sometimes prepared for by an alteration in the coats of the vessels. Generally only one or two branches are ruptured, and a single eye affected. In effusions of blood into both eyeballs we ought to suspect the presence of albuminuria or diabetes, &c.

Exudation.

3. *Exudations from the retina.*—In these cases effusions of blood are observed in the course of the arteries. Often one or two principal branches are ruptured, and a considerable quantity of blood effused. Besides these extravasations we see white spots of exudation over different parts of the retina, especially round about the yellow spot. The affection is now no longer confined to a single eye.

Embolism.

4. *Embolisms of the central artery of the retina.*—These are followed by weakness, or total loss of vision, coming on without any warning. The central arteries are contracted; the retina takes at first a white colour, the result of serous suffusion. There is a red spot more or less marked beside the macula lutea, and the vessels which supply it are congested.*

It is hardly necessary for me again to discuss the subject of optic neuritis and white atrophy of the optic disc, as leading to loss of sight; but I would refer the reader to the sections treating specially on these affections in reference to their being a cause of amaurosis. But we may with advantage glance at some of the principal affections of the brain, leading to progressive atrophy of the optic nerve and ultimate loss of sight.

Amaurosis in brain diseases.

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* Dobell's report on Progress of Medicine, vol. ii. p. 24.

In basilar meningitis.

Basilar meningitis, especially in its chronic form, may induce amaurosis. The patient suffers probably from fever, and great pain in the head increased on tapping the side of the head; vomiting, and so on, may be present. As this disease extends, several of the large nerves springing from the base of the brain become paralysed, among them the optic nerve. The blindness occurs with the head symptoms, and often runs its course rapidly in the more acute cases; but in the chronic form of the disease, the characters of the phenomena vary, and the appearances noticed with the ophthalmoscope are less those of neuritis than of white atrophy. It occasionally happens that the amaurosis follows this attack of meningitis in place of accompanying it, and is explicable on the supposition that the neo-plastic growths consequent on the inflammation have grown on and around the vascular and nerve structures, leading to their gradual wasting and decay.

In Cranial Periostitis.

Periostitis of the base of the brain may produce amaurosis, either of one or both eyes, or only hemiopia, according to the situation of the new growth. The amaurosis under these circumstances is probably most frequently induced from an extension of the inflammatory process to the sheath of the nerve; and as this action may be acute or chronic, so, as a general rule, shall we notice symptoms of neuritis or simply white atrophy.

From cerebral tumours.

Tumours of the base of the brain are doubtless sometimes the cause of loss of sight; involving, as they necessarily must do at times, the optic nerve. In the greater number of such cases loss of vision is brought about by means of the pressure of the morbid growth on the optic nerve, leading to white atrophy of the disc. It may be that the tumour, by exciting irritation in the structures among which it grows, may, either directly, or by involving neighbouring parts, lead to optic neuritis and its ophthalmoscopic appearances.

In acute diseases of the brain.

Acute disease of the brain in its various forms may result in amaurosis, such, for instance, as abscesses, softening, tumours of various kinds, cerebral hæmorrhage, and so on. The uncertainty in the diagnosis of disease of this description renders it very difficult for us to trace out the exact train of causes which result in loss of sight, although we may easily understand that any affection of the brain involving fibres continuous with those of the optic nerve, may compromise the integrity of the patient's sight. As the action on the nerve element is primary, or following upon irritation propagated from neighbouring structures, so will the disc, as a general rule, give evidence of white atrophy or of optic neuritis.

In spinal diseases.

Disease of the spinal cord is also a cause of partial, or complete amaurosis, the loss of sight being generally preceded by symptoms of spinal disease.* We must bear in mind the fact, that impairment of vision may occur in affections of the spine, from paralysis of the nerves which supply the ciliary muscle, causing loss of power of accommodation.

Prognosis.

Prognosis.—This is frequently rendered most doubtful, in consequence of the obscure nature of intracranial disease. But whatever the cause of the loss of sight, if the pupil responds to the stimulus of light, our prognosis will be a favourable one. As a general rule, our prognosis will be unfavourable if white atrophy of the optic disc exists. If it proceeds from deeply-lying parts it very probably will attack the root of the nerve, and so affect both eyes. In some few cases white atrophy of the disc has become stationary, and even recovery is said to have taken place from this condition; nevertheless, such cases are extremely rare. We should hardly judge of the condition of the patient's sight from the appearance of the disc; it may happen that the vision is better than the state of the optic disc would lead us to imagine.

Bad in white atrophy.

Better in optic neuritis.

Optic neuritis, though a formidable disease, presents a better hope of amendment than white atrophy. In these cases we rather dread the long-continued loss of sight than the more startling instances of rapid loss of vision, and the same remark applies to instances of white atrophy. If any sight remains we must, of course, carefully examine the state of visual field; and, as a rule, our prognosis must be unfavourable if we discover concentric limitation of the visual field—the more so, if the lateral limitation is irregular, as this condition generally depends on apoplectic destruction of tissue. Stellwag von Carion observes, if hemiopia

Condition of the visual field.

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* Dr. Argyll Robertson, *Edin. Med. Journal*, Feb. 1869.

occurs on the same side of both eyes, and is sharply bounded by the vertical line of separation of both visual fields, and also if it be accompanied by atrophy of the corresponding half of the optic papilla, it is to a certain extent favourable; that is, it is seldom followed by complete blindness, especially when it has existed for some time unchanged. But if the loss of vision advances with indistinct outlines over the centre of the retina, the worst is generally to be feared. In the remaining varieties of hemiopia the conditions are too unfavourable for the limitation of the original disease to enable us to hope for a pause in its progress. Such cases generally go on to complete blindness, with progressive atrophy of the optic nerve.

Sharp limits favourable.

Small lateral limitations act in about the same way. A further increase is not probable, whether the defect is monocular or symmetrical in both eyes, if it ends in a sharp line far from the centre, and if the relative sharpness of vision be normal in the other parts of the field of vision, and if, besides, the defect has not existed for a very long time. But limitations with very indistinct and irregular borders, with evident diminution of the relative acuteness of vision in the remaining parts of the field, cause us to give the worst prognosis. This is true even if the atrophy be not yet observed. The patient is in a particularly bad state when repeated examination shows a continuous loss of sight, and the appearance of similar defects in the other eye. Then we certainly have a progressive atrophy, which seldom ceases before complete amaurosis results.

Ill defined ones bad.

Limited interruptions.

Central and eccentric interruptions, when they occur in a visual field which is in other respects normal, are not apt to depend on progressive atrophy. We may exclude the idea of the latter, when the interruptions have been of the same extent for a long time. It is all the same, then, whether they exist in one eye or both; even a partial paleness of the optic papilla does not alter the case. But we generally have a progressive atrophy when they are combined with marked lessening of the relative acuteness of vision in the remaining portions of the visual field, especially when the loss of vision decreases very irregularly in different directions towards the periphery.

Treatment.

Treatment.—This must, of course, depend on the cause of the amaurosis; in one case drugs, in another electricity, may be employed; and in all, as far as practicable, the state of the patient's general health should be carefully attended to. I may mention one point, and that is with reference to the use of spectacles; in all forms of amblyopia we may with advantage limit the patient to use the lowest convex glasses he can see with, and it may very possibly happen that subsequently he may be able to get on with a higher power, the sight improving under the use of convex glasses, which not only save a strain on the accommodation of the eye, but increase the clearness of letters and other small objects.

Spectacles.

CHAPTER XII.

DISEASES OF THE VITREOUS.

Hyalitis—Muscæ—Opacity: syphilitic and anæmic—Films—Fluid vitreous—Sparkling synchysis—Hæmorrhage—Entozoa—Foreign bodies.

Hyalitis.

Hyalitis, or Inflammation of the Vitreous, may be induced by the presence of a foreign body, purposely passed through the vitreous chamber.* In instances of this kind, Donders describes changes occurring around the foreign substance, similar to those noticed in other parts of the body during inflammation.

Simple form rare.

These pathological alterations may occasionally be traced when a foreign body, such as a piece of gun-cap, has accidentally passed into the vitreous. From proliferation of its cells the vitreous becomes hazy, the foreign body being enveloped in a greyish layer of opaque material, and branching out from this centre of irritation opaque streaks may be observed. Subsequently the connective tissue breaks down, and the vitreous having become fluid, thread-like fibres may be seen floating about in it. These instances, however, must be very rare, for in the majority of cases the choroid and retina become involved, and it is then impossible to determine how far the changes observed in the vitreous are due to extraneous sources.

Mostly complicated.

Pus doubtless collects at times in the inferior part of the vitreous chamber, especially after the operation of reclination of the lens, forming what is called a posterior hypopion; but I am not disposed to admit the existence of such a disease as idiopathic suppurative hyalitis; in fact, with Dr. H. Pagenstecher, I doubt the correctness of those who describe inflam-

Posterior hypopion.

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* M. Wecker, "Maladies des Yeux," vol. ii. p. 282.

matory changes under these circumstances. Doubtless we meet with instances in which the vitreous becomes clouded, rendering the details of the fundus of the eye indistinct, or it may be invisible: but these conditions without question are due to previously existing alterations in the choroid. I do not in fact believe in the existence of "simple idiopathetic hyalitis."

Muscæ Volitantes.

Muscæ Volitantes.—Muscæ volitantes appear to the patient under various forms, floating about in the field of vision; they are often very annoying, but unlike scotoma they do not interfere with the perfection of vision.

Motes in the field of vision.

They appear to the patient to consist at times of slender rings, which seem to ascend from the lower part of the field of vision and then to fall down again. In other cases they take the form of pearly strings, which twist and twine about in all directions, or they may be seen as fine bands hovering about in the visual field. They are most distinctly seen when the patient looks at some clear bright object, as, for instance, at the sky or a white wall; in a dim light they are probably not visible. After overworking the eye they are very apparent, and also if the digestive organs are out of order.

Shadows of cells and films in vitreous.

These various appearances are due to the presence of minute pale cells, or of granular fibres or shreds in the vitreous humour,* and the shadows which these cast on the retina are the direct cause of the muscæ volitantes noticed by the patient in the field of vision. In some few instances it appears that opaque globular spots, situated among the fibres of the lens, may, by intercepting the rays of light falling on the retina, produce the appearance of muscæ volitantes.

Of small consequence.

Muscæ, therefore, are by no means a symptom of any great consequence, and are often observed in persons whose eyes are perfectly healthy. The cells and filaments of muscæ volitantes are too minute to be seen with the ophthalmoscope, and are thus distinguished from opaque membranes floating about in a fluid vitreous, which may be detected without any difficulty with the ophthalmoscope, and which are invariably pathological products, and therefore a matter of serious consideration. Short-sighted persons are very apt to suffer from muscæ, in consequence of the increased circles of diffusion cast by the minute bodies on the retina; we may comfort such patients with the assurance that the muscæ are not a symptom of serious disease.

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* "Accommodation and Refraction of the Eye," by F. C. Donders, p. 199: Translated by Dr. Moore: New Sydenham Society.

How differing from scotoma.

Muscæ differ from scotomata in that the latter follow the movements of the eye, as dark spots along the lines of a page in reading and writing, and do not float about as ill-defined shadows, an appearance characteristic of muscæ volitantes. Moreover, in the case of scotomata, the ophthalmoscope usually enables us to detect abnormalities in the retina, which account for the "dark spot" noticed by the patient.

Treatment.

Correct gastric disorder.

Treatment.—It will often be found that cases of muscæ depend on gastric derangement, or at any rate occur when the stomach or liver is out of order; and a little attention bestowed on these organs will do much towards removing the muscæ. In other cases, rest and a tonic plan of treatment are of service. Lastly, it should be remembered that muscæ sometimes remain stationary for years, and then disappear of themselves. Tinted glasses often prove useful to patients suffering from muscæ.

OPACITY OF VITREOUS.

Generally syphilitic.

OPACITIES OF THE VITREOUS.—Opacity of the vitreous varies in its degree from a cloudiness, to that of opacity, so dense, that we cannot see the optic disc through it: this condition of the vitreous is present to a slight degree in many cases of glaucoma depending on hypersection of serous fluid into the vitreous chambers. Opacity of the vitreous is most commonly met with, however, as a sequence of disease of the choroid, often the result of either inherited or acquired syphilis. Excluding this class of cases, opacity of the vitreous is most commonly seen among patients suffering from sclero-choroiditis posterior. Another cause of opacity of the vitreous is extravasation of blood from rupture of one or more of the choroidal vessels.

Changes in vitreous slow.

When from hereditary syphilis, sets in about age of eighteen.

May be overlooked.

If depending on inherited syphilis the changes in the vitreous usually take place very slowly, and the structure may at any time gradually clear and become transparent; or, on the other hand, if the degenerative process continues, it may lose its consistency, and pass into a fluid state. Flocculent masses will then be seen floating about in it; while, from the loss of the support which, under ordinary circumstances, the vitreous affords the retinal vessels, they may give way, and blood become effused in the retina. These abnormal changes, under the circumstances, generally commence when the patient is about eighteen years of age. The disease is accompanied with no pain in the eye, and the patient complains of no inconvenience beyond the gradually increasing loss of sight, which is most marked after sunset. At first, therefore, the symptoms are apt to be neglected. On making an ophthalmoscopic examination, the real nature of the disease will be discovered.

Examine by direct process,

and lateral illumination.

Changes in these structures are most readily detected by the direct process of examination; in fact, we should always make a point of examining an eye by this means before using the indirect method; a fluid or hazy vitreous may be overlooked for want of this precaution. If, however, there is any doubt in our mind as to the condition of the lens, we should invariably employ lateral illumination; by this means it is almost always possible accurately to define structural changes in that situation, and should there be any opaque lines or dots in it, they may be distinctly seen, and the nature of the disease determined without any further trouble.* In the majority of cases of incipient cataract we shall discover one or two landmarks of this description.

Patchy opacity of the fundus,

In examining cases of syphilitic opacity of the vitreous, we may frequently notice that the fundus of the eye appears to be deeply opaque in patches, situated apparently behind the vitreous; this condition of the parts is generally caused by disease of the retina

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Handybook of Ophthalmic Surgery," p. 97, by J. Z. Laurence and R. C. Moon.

and choroid. It is very rare to find the vitreous itself so densely opaque as entirely to obscure the reflection of light from the fundus of the eye: a dull, foggy glimmer from the retina may almost always be noticed through the diseased humour. But when, in addition to this, the reflections from definite portions of the fundus are particularly dull, we must be guarded in our prognosis; it is more than probable that in such cases, if the vitreous clears, we shall discover further mischief to have taken place behind it, in the retina or choroid.

from changes in retina or choroid.

The following instance illustrates the ordinary course of opacity of the vitreous when occurring in a patient affected with secondary syphilis, and no doubt, as in all these cases, depended on disease of the choroid in the first instance, affecting the nutrition and transparency of the vitreous:—

Case.

Opacity of vitreous in secondary syphilis.

Case.—Sreenath Sing, aged thirty-three, contracted venereal disease some four years ago; this was followed by secondary symptoms, from which he has suffered more or less up to the present time; he was salivated three months since without deriving the slightest benefit from the treatment. A year after the chancre had healed he noticed that his eyesight began to fail, and from that time the dimness of vision has steadily but slowly increased, without his having suffered the slightest pain in the eyes, nor do they appear to have been congested or irritable.

Health impaired.

When he first came to the hospital, his general health was evidently very much impaired; he had a small weak pulse, and was very emaciated; he complained also of severe rheumatic pains in his limbs; he was almost completely blind with the left eye, and could barely discern fingers held up before the right one. The tension of both eyeballs was normal, and though the irides acted sluggishly, still no abnormal appearance could be detected in either cornea, lens, or iris. With the ophthalmoscope, I found the vitreous humour of the left eye so densely opaque, that it was impossible to see the optic disc; in the right eye the vitreous was of a hazy, whitish-grey colour, but I could just distinguish the retinal vessels through it. The treatment upon which he was put consisted of a liberal diet, cod-liver oil, and iodide of iron. Under this his general health certainly im-

Dense opacity of the vitreous.

Liberal diet and tonics.

proved, but at the end of a month, there being no perceptible change in the condition of his eyes, I ordered him to commence a course of mercurial baths, and an issue was opened in the skin of either temple.

Improved by treatment.

It would be useless my following out the details of this case from day to day: our patient continued the use of the vapour baths for two months, and at the end of that time he could see to read No. 4 type, and so transact his business without inconvenience. On examining his eyes with the ophthalmoscope, I found that the left vitreous, though still hazy, had so far cleared as to allow of my seeing the optic disc. The right eye was perfectly healthy, as far as I could discover.

Common in India.

I have already stated that we frequently meet with instances of this form of disease among the natives of India, syphilis being very prevalent among them; and unfortunately they commonly fall into the hands of ignorant quacks who starve, and at the same time salivate them most profusely for the cure of venereal disease.

Opacity of vitreous from anæmia.

Anæmic and Malarious Opacity.—It by no means follows, however, that opacity of the vitreous is always a consequence of syphilis. The following is a case in point, the changes in the vitreous depending upon general impairment of nutrition and poverty of blood:—

Case.

Anæmia.

Case.—Omesh Chunder Roy, aged thirty-two, an anæmic individual, by occupation a writer, states that, about five years ago, he discovered his eyesight was gradually becoming defective; dimness of vision, more particularly after sunset, was first noticed, but latterly he has constantly seen opaque spots floating about before his eyes. He cannot see to read the largest sized type with his left eye; with difficulty he can decipher No. 4 with the right. I found the cornea, iris, and lens, in both eyes, healthy, the tension of the left being about (T—1.), that of the right (T. N.). In the former, the vitreous was in a fluid condition, and a number of flocculent bodies were seen floating about in it; the optic disc and vessels of the retina were indistinctly seen, as through a dense fog. The right vitreous was slightly hazy, but in other respects the eye appeared normal.

Gradual impairment of vision.

Vitreous hazy and fluid.

The patient was ordered to take five grains of iodide of potassium, three times a day, and he continued this medicine for some time without any apparent improvement; I then gave him cod-liver oil and bichloride of mercury, for two months, with marked advantage. At present, the fundus in either eye appears healthy; in the left, the vitreous has so far improved that the tension is normal, and the optic disc and vessels of the retina can be distinctly seen, although a few flocculent bodies are still to be noticed in it. The patient can see to read No. 1 type with either eye, the right being perfectly healthy.

Greatly improved by treatment.

Non-syphilitic opacity of the vitreous commonly arises (excluding cases depending on disease of the choroid) from an impoverished state of the blood induced by malarious influences. I need hardly remark that, among the lower classes of natives, anæmia is very prevalent; and under these circumstances, an attack of fever is likely to cause further deterioration of the blood, and also local congestions of the choroid and other structures; and the vitreous, like the cornea, is prone to degenerate and become opaque.

Malaria a frequent cause.

If the opacity of the vitreous is thus due to an impoverished state of the blood, it is evident that good food, quinine, and cod-liver oil are imperatively called for. I place great faith in cod-liver oil, arsenic, and strychnia, in such cases.

Treatment

In instances of sclero-choroiditis posterior, the vitreous, as a general rule, commences to grow cloudy towards the back of the eye; at the same time this portion of the vitreous is apt to become fluid, and opaque patches are then seen floating about in it.

Films in Vitreous.

FILMS IN THE VITREOUS.—Occasionally colourless flocculent bodies or films are seen stretched across the vitreous chamber, like a thin veil in front of the retina. These consist, probably, of the cellular structure of the vitreous, rendered opaque by degenerative changes. Professor von Graefe has removed opacities of this kind by passing two needles into them, and breaking them down, in the same way as Mr. Bowman directs for the removal of an opaque capsule from behind the pupil.*

May be broken down.

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* Carter's Translation of Zander [illegible] the Ophthalmoscope," p. 224.

Another cause of opacity of the vitreous is the effusion of blood into this chamber, as I shall presently explain more fully.

FLUID VITREOUS.

Associated with muscæ.

FLUID VITREOUS.—The vitreous may pass into a fluid condition, but still keep transparent; and if it happens that opaque membranes or neoplasms are formed in it, their shadows are seen by the patient as objects floating in the field of vision, as I have already explained in the previous sections on opacities of the vitreous.

In cases of increased tension.

In atrophy.

This fluid state of the vitreous may exist without any diminution in the tension of the eyeball, for it is met with in cases of glaucoma, and sometimes in connexion with tumours of the choroid; in fact, pressure exercised on the vitreous appears directly to favour its passage into a fluid condition. On the other hand, in atrophy of the globe following choroiditis, the vitreous also very commonly becomes fluid, and the same result sometimes supervenes on senile changes in the eye, especially if the vessels of the choroid are involved.

In staphyloma.

In advancing posterior or anterior staphyloma, we sometimes find the vitreous becoming fluid, the patient complaining of dark objects floating about in the field of vision. Not only does the disease of the choroid in these cases affect the integrity of the vitreous, but, from the bulging outwards of a portion of the vitreous chamber, the lens is apt to recede from the iris, augmenting the defects in the refracting media of the eye, and rendering the pupil somewhat tremulous.

Ophthalmoscopic appearances.

It so generally happens that the fluid vitreous contains dark-coloured specks and shreds floating about in it, that there is no difficulty in detecting the nature of the disease with the ophthalmoscope. (*Vide* Opacities of the Vitreous.)

SPARKLING SYNCHYSIS.

SPARKLING SYNCHYSIS.—A remarkable condition of the vitreous, called sparkling synchysis, is occasionally seen, depending upon the presence of innumerable particles of cholesterine floating about in it. With the ophthalmoscope, they appear like a multitude of grains of gold-leaf, whisking about in all directions when the eye is turned quickly from one side to the other.

From degenerate lens.

This material generally arises from degenerative changes taking place in a dislocated lens; a great part of the lenticular matter becoming absorbed, the insoluble cholesterine is left in the vitreous chamber.

Among the natives of India these appearances are sometimes seen, in consequence of the lens having been thrust down into the vitreous, in the operation of depression or reclination for the cure of cataract. We not unfrequently have patients applying for relief at the Ophthalmic Hospital under these circumstances, suffering from atrophy of the retina and choroid, together with sparkling synchysis.

BLOOD IN THE VITREOUS.

From blows or diseased vessels.

Appearances.

Hæmorrhage into the Vitreous.—It is by no means uncommon to meet with cases in which an effusion of blood into the vitreous has taken place, in consequence of a blow, or else from rupture of diseased vessels in the choroid or retina. For instance, a person is struck on the eye, and independently of chemosis, he finds that he cannot see clearly, the field of vision being obscured by a reddish haze. With the ophthalmoscope, the vitreous will appear of a diffused, bright scarlet colour, the optic disc being dimly seen through it; spots of ecchymosis will probably also be observed in the retina.

Quickly absorbed.

A central clot may impair sight.

The effused blood may be rapidly absorbed, and the vitreous return to its normal state of transparency; but if the hæmorrhage has been at all profuse, a clot may be formed in the axis of vision, rendering the patient more or less blind. The fibrine of a clot of this kind usually undergoes fatty degeneration, and gradually becomes absorbed; but hæmorrhage into the vitreous may lead to opacity and further degeneration, and consequent fluidity of that structure; on this account we should be guarded in giving a favourable prognosis in such a case: moreover, the clot may remain *in situ;* and should it even disappear, we may subsequently discover that considerable injury has been done to the retina, and that its functions have become permanently impaired.

Diagnosis.

There can seldom be any difficulty in forming a correct opinion with respect to the nature of a lesion of this kind; for if the hæmorrhage has occurred in consequence of an injury, the impairment of vision will have originated at the time the blow was inflicted; but if from the effects of disease, the history and symptoms, together with the ophthalmoscopic appearances of the part, will sufficiently determine the diagnosis. It is possible that a malignant growth in its earliest stages, or a separation of the retina from the choroid, might be mistaken for a clot of blood in the vitreous chamber; a little care, however, bestowed, on the inspection of the part, will speedily remove any doubt there may have been on the subject. If the case should be one of malignant tumour, the aspect of the excrescence can hardly be mistaken, the pain and tension of the eyeball, combined with the ophthalmoscopic appearances, indicating the serious nature of the mischief going on in the eye. By means of the lateral method of examination, the tumour may generally be clearly defined, as soon as it projects slightly beyond the plane of the fundus of the eye.

A malignant growth mistaken for a clot.

Distinguished by its history and form.

ENTOZOA.

Hydatid cysts.

ENTOZOA IN THE VITREOUS.—Cysticerci are occasionally found in the vitreous chamber, the cyst in which they grow being attached to the retina or choroid. Dr. Liebreich states that the entozoon is first developed behind the retina, and having perforated it, enters the vitreous chamber. A contracting and elongating movement of the cyst may be clearly observed, though the parasite itself cannot be distinctly seen, on account of the opaque sheath in which it is contained. After a time the cyst bursts, and the head and neck of the creature may then be defined. It is, however, remarkable that, up to this stage of the disease, the parasite appears to cause no inconvenience beyond the shadow cast by the wavy motion of the cyst in front of the patient's retina; there is no pain or irritation in the eye.

Cause little trouble for a time.

Liebreich's case.

Successful removal.

Dr. Liebreich relates a case of a cysticercus in the vitreous, which he not only diagnosed, but removed: passing a pair of canula forceps into the vitreous, he seized the parasite and withdrew it from the eye. During the operation, he contrived to illuminate the vitreous with an ophthalmoscope which he fixed to his forehead, enabling him to use both his hands, and thus accomplish the necessary manipulation.* Cases of a similar kind have from time to time been recorded;* in some the lens was first extracted, and subsequently the parasite removed; these operations, however, have not been very successful.

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* "Atlas d'Ophthalmoscopie," par le Dr. R. Liebreich, p. 18.

Filariæ in horses.

In many parts of India *filariæ* are frequently found in the eye of the horse: the entozoon is seen in the anterior chamber, moving about like a thin white thread in the aqueous humour. In the early stages of the disease it excites no irritation or inconvenience, but ultimately inflammation and ulceration of the cornea occur, and the contents of the eye, together with the parasite, are evacuated. This may generally be averted by puncturing the cornea, and allowing the aqueous to gush out through the aperture, and with it the entozoon.† The filaria has also been found in the human vitreous.‡

FOREIGN BODIES IN VITREOUS.

FOREIGN BODIES.—The ophthalmoscope is of the greatest assistance in enabling us to estimate correctly the position of foreign bodies in the vitreous, and there is no class of cases that demand our more earnest consideration, for the sight of both eyes is frequently compromised, the one by direct injury, the other from sympathetic irritation. As an instance of the aid afforded by the ophthalmoscope, we may refer to a case in which a small particle of steel had penetrated the upper eyelid and sclerotic, and entered the vitreous chamber. The patient was under Mr. Dixon's care, and on examining the eye with the ophthalmoscope, he was enabled to detect the foreign body behind the lens. Mr. Dixon removed it by perforating the sclerotic at its lower and outer part, and passing a pair of canula forceps into the vitreous, with which he caught hold of the foreign substance and so withdrew it from the eye. The patient made a rapid recovery.

Detected with the ophthalmoscope.

Should be removed without delay.

It is impossible to lay down special rules in treating accidents of this kind; almost every instance we meet with will require some peculiar manipulation, and we must exercise our own judgment, ingenuity, and mechanical skill in contriving the most appropriate means for accomplishing our purpose. With the ophthalmoscope, a foreign body may usually be defined, if sought for soon after it has penetrated the vitreous chamber; but after remaining there for some time, it is likely to become hidden by a covering of false membrane. The following case is an instance in point:—

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* Carter's Translation of Zander, p. 162.

† See *Indian Annals*, No. 26.

‡ Carter's "Zander," p. 191.

After a time become hidden.

Case.—Mr. ——, last cold season, was struck in the eye by a No. 3 shot, which penetrated the lower part of the sclerotic. He gradually lost his sight, and I was consulted regarding the case, some two months after the accident had occurred. I found that he was quite blind with the right eye; the pupil was dilated, and the vitreous hazy, the sclerotic and conjunctiva were slightly congested (T.N.); the patient suffered no pain in the eye. On examining it with the ophthalmoscope, I found the retina detached from the choroid, and at the bottom of the vitreous chamber the shot could be seen encased in a whitish mass. As there was no possibility of restoring the sight, and as the foreign body did not appear to cause any irritation, I directed my patient merely to keep the eye closed with a pad and bandage, and after a short time the conjunctival congestion entirely disappeared.

Case.

A shot left in the vitreous.

Retina detached and sight lost.

Unfortunately, in India, we constantly meet with instances of a foreign body in the vitreous, in the shape of a dislocated lens, for the uneducated native practitioners usually operate for the cure of cataract by reclination. Suppose a patient is brought to us in great agony, with his eye violently inflamed from a recently performed operation for depression. On examination, we see the opaque lens bobbing about behind the iris, and it is necessary to decide at once as to the treatment to be pursued under the circumstances. If the lens has been depressed within a week or so, and the patient has still some perception of light, we should attempt to save the eye, removing the lens by linear extraction. We may experience some difficulty in accomplishing this, on account of the adhesions which will probably have formed between the iris and the lens. If the dislocation has existed for more than fourteen days, and the patient is suffering from considerable pain in the eye, and has lost all perception of light, it is better to cut through the

A dislocated lens in the vitreous.

Excites severe inflammation.

Should be extracted if recent,

cornea at once, and turn out the contents of the eyeball; any palliative treatment we may adopt must expose the patient to the risk of losing the other eye from sympathetic irritation; and there is no chance of the diseased one being, in future, anything but a source of annoyance and pain, so that the sooner it is destroyed the better.

or the eye evacuated.

CHAPTER XIII.

DISEASES OF THE LENS.

Pathology of cataract—Lenticular cataracts—Soft—Cortical—Hard—Treatment—Preparation of patient—Operation—Depression—Solution—Flap extraction—Modifications—Linear extraction—Traction operation—Modified linear extraction—Linear extraction without iridectomy—Choice of an operation—Capsular cataract—Traumatic cataract—Dislocations of the lens.

PATHOLOGY OF CATARACT.

CATARACT.

An opacity of the lens,

CATARACT.—The subject which will almost exclusively engage our attention in this chapter is that of opacity of the lens, or cataract.

other structures being healthy.

The term cataract should be restricted to instances of opacity of the lens in which, so far as we can ascertain, no disease exists in any of the other structures of the eye. The tension of the eyeball is normal; the patient does not experience sensations of flashes of light before his eyes; the iris is healthy, and responds, though it may be slowly, to the stimulus of light. In fact, the symptoms of cataract are gradually increasing dimness of vision, which is accounted for by advancing opacity of the lens. If the opacity is in the capsule, and the lens is transparent, the term capsular cataract is employed. If both lens and capsule are opaque, we call the condition a capsulo-lenticular cataract.

Causes.

Causes.—The causes of cataract, excluding traumatic and capsular cataracts, have long been a subject of dispute. It is possible that, in some instances, alterations in the constituents of the blood have a direct influence on the formation of cataracts, as, for example, in diabetes; nevertheless it is a mistake to fancy that persons suffering from diabetes are very subject to cataract;

and it is a still greater mistake to suppose, such persons do not make good recoveries after operation. Dr. F. Kunde,* increasing the specific gravity of the blood by injecting saline solutions into the intestines of living frogs, found that their lenses became opaque, and the opacity disappeared as soon as the consistency of the circulating fluid was restored. He also discovered that by freezing these animals their lenses were rendered opaque, and arrives at the conclusion that molecular changes taking place in the tubes (of which he conceives with Kölliker that the lens is composed) render the crystalline opaque. So far as the tubes of the lens are concerned, I cannot agree with M. Kunde, but when we consider that the lens contains upwards of 60 per cent. of water in its normal state, we may readily concede this much, that alterations in the specific gravity of the blood may very well occasion such molecular changes in the lens as shall render it temporarily opaque. But admitting all this, it hardly brings us nearer the solution of the question as to the actual cause of cataract, more especially as we find, in certain diseases attended with a great drain of water from the blood, as cholera, that opacity of the lens does not occur.

Artificial production of.

From temporary molecular changes in the lens.

No parallel in pathology.

Cataract appears in very many cases to be due to fatty degeneration of the lens fibres, and this condition may be induced by causes affecting its nutrition, whether arising from alterations in the blood, from defective innervation, or from mechanical separation.

Spontaneous cataract, fatty.

Traumatic cataract may be induced, as in the experiments of Dr. A. Moers,† by passing a fine thread through the lens. In the first instance, changes occur in the cells lining the capsule, these give rise to rapidly increasing cell-growths, and as this process advances, alterations take place in the nucleus of the lens, which becomes opaque, and lastly, its cortical substance is involved in the degeneration.

Traumatic cataract.

Experiments of Moers.

Classification of Cataracts.—Cataracts may be divided into two classes, the lenticular and capsular; in the former the lens is involved, and in the latter the

Classification of cataracts.

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* "Zeitschrift für wiss. Zoologie," von Siebold u. Kölliker, Bd. viii. p. 446, 1857.

† "Arch. für Path. Anat.," von R. Virchow, Bd. xxxii. p. 45, 1864.

capsule; or rather, the inner or outer surface of the capsule becomes opaque, in consequence of the formation of neo-plastic growths in this situation. Lastly, we shall have to consider the circumstances of traumatic cataract.

LENTICULAR CATARACT.

LENTICULAR CATARACTS may be described under four heads: the soft, cortical or mixed, senile or hard, and zonular cataracts.

1. Soft cataract. In the young.

1. *Soft Cataract* is most commonly met with among infants and young people, the patients being under thirty years of age.

Contents of capsule fluid.

In instances of soft cataract the fibres of the lens not only undergo fatty degeneration, but are disintegrated and broken up. On account of the contents of the capsule being fluid, it bulges forwards, pushing the iris before it, and lessening the antero-posterior diameter of the anterior chamber.

Looks like cream.

Opacity extends to margin.

It is hardly possible to mistake this form of cataract; the pupil being fully dilated with atropine, the opaque lens appears like a bag full of creamy fluid, being perfectly free from striæ, whether examined by direct or transmitted light. A few opaque or chalky-looking spots are occasionally noticed on the inner surface of the capsule, and now and then flakes of cholesterine may be seen in it. On examining the lens with the ophthalmoscope, it will be found that the opacity reaches to the circumference of the lens, so that we cannot possibly see any portion of the fundus of the eye in these cases.

May be absorbed,

leaving an opaque membrane.

It sometimes happens that the contents of the capsule when fluid are gradually absorbed, with the exception of a small quantity of its earthy material, which attaches itself to the inner surface; at the same time the capsule shrinks, so that ultimately we notice a white, irregular-looking membrane, situated behind the pupil, and by transmitted light its surface appears wrinkled. The opacity seems to be placed at some little distance behind the iris, a space evidently existing between the pupil and the opaque membrane.

Often very tough.

The remains of a soft cataract of this kind are generally very tough, and the elasticity of the capsule having been greatly impaired, or lost, it is difficult to destroy these membranes with a needle; they are better taken away by opening the anterior chamber, and seizing the opaque capsule with a pair of forceps, when it may be withdrawn from the eye.

2. *Cortical, or Mixed Cataract.*—Until the age of forty the nucleus of the lens is hardly distinguishable from its cortical substance, and as the so-called cortical cataract often occurs before this age, the term is scarcely well chosen to distinguish this form of the disease from opacities involving the nucleus of the lens.

2. Cortical cataract in middle age.

Name ill-chosen.

The first appearance of a cortical cataract is generally observed as a series of striæ, commencing at the circumference of the lens and converging towards its centre. The striæ are often situated at some distance behind the iris, in the posterior layers or substance of the lens; the pupil having been dilated with atropine this condition is best seen by the direct method of examination; or by lateral illumination. As the cataract advances, the striæ increase in breadth and length, and become of a whitish colour; the younger the patient, and the more rapid the advance of the cataract, the broader and more mother-of-pearl like the opaque bands in the lens appear. They ultimately occupy the entire lens, when the cortical cataract is complete.

Striæ begin at circumference.

The fully formed cataract presents the following appearances: undilated, the pupil lies immediately on the opaque lens, the degenerated cortical substance extending up to the anterior capsule.* The pupil having been dilated with atropine, the lens appears uniformly opaque, and is marked with bands of mother-of-pearl or opal-like appearance; the centre of the lens may present a slightly yellowish tint, and by transmitted light it will be seen to be of a denser consistency than its circumference. This point is best determined, however, by the ophthalmoscope; with the aid of this instrument we shall discover that the margin of the lens allows a certain number of the rays of light to pass through it, and a reddish reflection may be observed from the fundus of the eye; the denser central portion of the lens entirely obstructs the rays of light from reaching the choroid, and appears as an opaque mass, surrounded by a dim reflection

When fully formed, the iris lies on the cataract.

Opal-like bands.

Margin of lens less dense.

Allows a reflection from the retina.

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* "Maladies des Yeux," M. Wecker, Vol. ii. p. 150.

from the fundus through the circumference of the lens. In the case of a soft cataract no such coloration is observed, nor are there any striæ to be seen on its surface. If the cortical cataract appears in a person advanced in life, or is of long standing, the fibrous bands of the cortical substance are less marked, and the centre of the lens (its nucleus) assumes a more decidedly amber tint.

3. Senile cataract.

3. *Senile, or Hard Cataract.*—One of the difficulties we meet with in tracing the characteristic appearances of a senile cataract, arises from the slow invasion and indefinite character of the disease in its early stages.

Lens opaque with age.

As a person advances in life, senile changes take place in the lens by which its nucleus is rendered amber-coloured and in some degree opaque, and yet the individual may possess very good sight, at most being only presbyopic, and is not considered to have cataract; but if this degeneration advances, and the nucleus of the lens becomes sufficiently opaque to prevent the rays of light from reaching the retina, a senile cataract is then said to exist.

Rare before forty-five.

Characteristic amber nucleus.

Opalescent striæ.

Cortex semi-transparent.

This form of cataract seldom occurs in a patient under forty-five years of age. In its early stages the lens presents a yellowish, or amber colour, most marked in its centre, and a clear space may be seen to exist between the pupil and the opacity, the cortical substance of the lens being comparatively unaffected. On dilating the pupil, we shall notice opalescent striæ extending from the circumference towards the axis of the lens. As the disease advances the striæ become deeper and more distinct, but still the prominent feature in the lens is its amber-coloured centre, which is indeed the principal characteristic of the hard cataract. On examination with the ophthalmoscope, the circumference of the lens will be found to be less opaque than its nucleus, and a reflection from the fundus of the eye will be observed. It is in consequence of the nucleus of the lens being most early involved in cases of this kind, that patients see better after sunset, or when the pupil is slightly dilated, so that rays of light can pass through the margin of the lens to the retina. A weak solution of atropine, if applied to the eye once or twice a week, by keeping the pupil slightly dilated, may enable such a person to walk about, or even read and write with comfort.

In these cases of senile cataract, we may frequently observe delicate spots on the inner surface of the capsule; they consist of fatty epithelium; and as these degenerative changes advance in the cells of the capsule, it becomes firmly glued down to the cortical substance of the lens, so that it is often difficult to separate the two. At the same time the lens becomes flattened from before backwards, and its circumference sharp and contracted; this, in fact, is the usual form of the lens after it has undergone senile degeneration, and become converted into a hard cataract.

Capsule spotted and adherent.

Lens flattened.

The length of time which a senile cataract takes to form is very uncertain. We are frequently pressed by patients to state how long they are likely to be able to read, or get about by the aid of the affected eye; but we must carefully avoid committing ourselves to an opinion on these matters, for it is quite impossible to determine, in any individual case, how long these senile changes may continue without producing blindness.

May take a long time to form.

4. *Zonular Cataract* is most frequently a congenital affection, but may occur in after life as an effect of irido-choroiditis.

4. Zonular cataract. Often congenital.

In infancy, opacities of the lens of this description may be overlooked, the child not showing any signs of defective vision until he is about two years old and begins to employ his eyes on small objects; even then he may see very well. I have now a young man under my care, nineteen years of age, who is affected with zonular cataract in both eyes, but is employed as a compositor, and states that his sight has not grown worse as long as he can remember; but from constantly holding his head close down to the type upon which he is engaged, so as to magnify the visual image, he has become intensely myopic; it was on this account that he lately consulted me.

Compatible with useful vision.

The opacity of the lens in zonular cataract is situated between the posterior cortical layers of the lens and the nucleus; it is seen, therefore, at some distance behind the pupil, the anterior cortical substance and the nucleus intervening between the opacity and the iris.*

Situated in posterior layers of the lens.

The pupil having been dilated with atropine, a whitish grey film is seen in the lens in the position above indicated, looking very much as though a piece of silver-paper had been stuck on to the posterior surface of the lens. The opacity is always greatest in the axis of vision, often appearing to be of a chalky consistency, with striæ radiating outwards from this central portion; the circumference of the lens is frequently perfectly transparent.

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* "Augenheilkunde," Stellwag von Carion, p. 621.

Opacity greatest in the axis.

These cases of zonular opacity may be divided into two classes, the stationary and the progressive. In the former, the opacity is always well defined, small, and the circumference of the lens perfectly transparent. If a zonular cataract presents appearances of this kind, we may be almost certain that it will not advance for years, or it may be for life. On the other hand, if in addition to the central opacity, we notice that the circumference of the lens is marked with small opaque dots, or striæ, we may be sure that the cataract will progress, and we must plan our procedure accordingly. These streaks and spots in the cortical substance of the lens are best seen by means of the lateral method of illumination.

Stationary form.

Progressive.

If an eye affected with zonular cataract be examined with the ophthalmoscope, we shall, unless in a far advanced case, see the fundus of the eye clearly through the circumference of the lens; and even through its densest portion a dim reflection from the back of the eye will be perceptible.

Fundus visible with ophthalmoscope.

It is a matter of considerable practical importance to diagnose between a stationary and advancing zonular cataract, for in the former the operation of iridectomy will be necessary, but if the cataract is advancing it is better to remove the lens.

Diagnosis important.

Several other rare forms of cataract have been described by various writers on the subject; among these *black cataract* has held a prominent place; this form of opacity of the lens appears to arise from an infiltration of hæmatine into the opaque lens,* and often indicates some deep-seated disease of the eye; choroido-retinitis has more than once been observed after extracting such a lens.

Black cataract.

The *calcareous or bony cataract* is another rare form

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* "Maladies des Yeux:" L. A. Desmarres, t. iii. p. 72.

Bony cataract.

of disease, the lens undergoing calcareous degeneration similar to that met with in other parts of the body.

TREATMENT OF CATARACT.

TREATMENT OF CATARACT.

Preliminary inquiry.

PRELIMINARY EXAMINATION.—Before describing the operations usually resorted to for the removal of an opaque lens, it will be desirable to point out certain preliminary considerations which should precede any operative interference, and the result of which must guide us in the choice of an operation, and the general management of the case. We should endeavour to ascertain, in the first instance, the special characters of the cataract to be operated on—first, as to its consistency, and secondly, as to the extent, of the cortical portion involved: and lastly, we should investigate the condition of the eye irrespectively of the cataract, the state of the patient's health, together with the preparatory treatment which may be necessary before the operation.

1. Nature of the cataract.

Zonular unmistakeable.

Diagnosis of soft.

1. *As to the Nature of the Cataract.*—There can be no difficulty in the diagnosis of a zonular cataract; but the question often arises whether the cataract is a fluid or a cortical one, and doubtless in some cases the two forms of cataract run into one another, and the character may then be obscure. But the pupil having been dilated with atropine, if the anterior surface of the lens appears to bulge forwards, the lens being uniformly opaque, and of a cream colour, no striæ, or only faint ones, being visible on its surface when examined by transmitted light, when, moreover, with the ophthalmoscope, we find the lens densely opaque up to its circumference,—under these circumstances, we may almost safely predict that the contents of the capsule are fluid.

Morgagnian cataract.

In some rare instances the nucleus may be hard and the cortex fluid (a Morgagnian cataract), in which case the hard nucleus can be seen floating about in the fluid lenticular matter. Cases of this kind are not likely to occur before the patient is forty years of age, for until that time of life the nucleus of the lens can hardly be said to exist.

Cortical known by its striæ.

The cortical cataract, when fully formed, presents the mother-of-pearl-like striæ, or bands, on its surface, which are characteristic of this form of opacity of the lens; but the opaline, fatty cortical substance may often enclose a hard nucleus, especially if the patient is upwards of forty-five years of age. We must always carefully examine an eye affected with apparently cortical cataract by transmitted light, and if we detect an amber tinge in its central part, we may fairly expect that its nucleus is a hard one.

Nucleus may be hard.

Senile amber-coloured.

Lastly, the amber colour of the senile cataract is hardly to be mistaken, especially if striæ are seen radiating inwards from its circumference, and if on examination with the ophthalmoscope we find the centre of the lens densely opaque, while its outer part allows a few rays of light to pass through it from the fundus.

2. Ascertain extent.

2. *Extent of the Cataract.*—Having formed our opinion as to the nature of the cataract, the next question is as to the extent to which the lens is involved;—is the whole of its cortical substance opaque or not? It is of considerable importance to determine this point, because, if the cortical substance of the lens is still transparent, during the extraction of the cataract the cortical matter may become detached and entangled in the iris, and, escaping our notice, it may subsequently set up inflammation in the part, and cause dangerous hyperaction in the deeper structures of the eye. If, on the other hand, the whole of the cortical substance is opaque, we shall more easily see any fragments of the lens which may happen to be left in the anterior chamber, and may generally remove them without difficulty with the scoop.

Transparent fragments dangerous.

Is a space seen between iris and cataract?

The best means we have of ascertaining the extent of the cortical substance implicated is, to examine the eye by transmitted light, noticing if the free margin of the iris appears in absolute contact with the opaque lens, or if there is a space between the pupil and the cataract; in the former case the anterior part of the cortical substance is evidently opaque; but if the iris appears separated from the cataract, some of the cortical substance of the lens is still transparent. We shall more readily observe these distinguishing features if the pupil has been very slightly dilated with atropine.

Proposal to hasten formation.

It has been proposed, in cases where the cataract has been long forming, and therefore causing considerable impairment of vision, but yet the cortex of the lens has not become wholly involved, to puncture the capsule, and thus hasten the degenerative process. Instances may sometimes occur where this plan is advisable, but I should generally prefer, having performed iridectomy, to extract such a lens in its capsule, so that none of the soft and transparent cortical matter might attach itself to the iris.

Another important question is likely to arise regarding the maturity of a cataract. Supposing that in one eye the lens is opaque, and in the other tolerably transparent, should we wait till both eyes are equally involved before operating, or should we remove the cataract at once? It seems better, without doubt, to get rid of the opaque lens under these circumstances, because there can be no valid reason for keeping our patient in suspense and discomfort till he is completely blind, when by operating on the one eye he may be able to use it, while the degeneration is progressing in the other, and may thus be enabled to perform the ordinary duties of life without interruption.

If one lens only is opaque, remove it.

It may be laid down as a general rule, that, when both eyes are involved, only one should be operated on at a time; I hardly know of any circumstances that would make me perform a double extraction at one sitting, unless in the instance of double traumatic cataract, when we should do well to relieve both eyes as soon as possible from the irritation induced by the swollen and opaque lenses.

Operate on one eye only at a time.

3. *As to the Absence of Complications.*—Before undertaking an operation for the cure of cataract, we must be fully satisfied that the case is one of pure cataract. This observation may appear superfluous; nevertheless the caution is very necessary, because opacity of the lens and cataract may be very different things. It is not necessary for me to recapitulate the characteristic symptoms of glaucoma, choroiditis, irido-choroiditis, and such like diseases, which implicate the lens and render it more or less opaque, because I have distinctly defined cataract to be an opacity of the lens arising from no such assignable causes. If, therefore, the iris is unhealthy or the tension of the globe is abnormal, the case is not one of simple cataract; and unless we are thoroughly acquainted with the various diseases which cause opacity of the lens, we cannot possibly undertake so serious an operation as extraction with any confidence of success.

3. Ascertain the absence of other disease.

It is always desirable to determine, before operating

Test the amount of vision,

for cataract, the amount of vision the patient possesses, for it may happen that in addition to the cataract he has atrophy of the disc, or detachment of the retina, or other disorganization—conditions which we could not ascertain by any external symptoms, and which may have come on so gradually, that the patient himself may be quite unaware of there being any complication of the kind. To determine the amount of vision, the pupil must be fully dilated with atropine; and I may here remark that *if the patient's pupil does not dilate readily on the application of atropine to the eye, it is an unfavourable sign*, the choroid, or iris, being very probably compromised. The action of the mydriatic being fully established, the patient is to be taken into a dark room, and the flame of a lamp held at various distances, and in different positions with respect to the eye; if he sees the flame with tolerable distinctness in all directions, particularly above and below the eye, we may be pretty certain that no detachment of the retina exists, and that the optic nerve is healthy. Even in the case of young children we may generally succeed in making an examination of this kind, and it is very necessary, for the soft cataract met with among infants, especially if accompanied with a rolling motion of the eyeballs, generally indicates deep-seated disease. Our prognosis in such a case will be far from a happy one, unless the little patient's attention is caught by, and his eyes follow, the flame of a candle held before him.

by dilating the pupil,

and using a light in a dark room.

4. Inquire as to general health.

4. *General Health.*—We must also take the circumstances of the patient's general health into our consideration before operating for cataract; if weak, or otherwise out of sorts, we must put off the operation until his health improves. The existence of chronic bronchitis is especially against the success of the operation. All that can be said on this subject is, do not operate if the patient is not in his usual state of health, and if he is, the less preparatory treatment he has the better, unless we propose giving ether, as I shall subsequently explain.

If good, no preparation.

Ascertain temper,

Besides carefully considering the state of the patient's health, we must also satisfy ourselves as to his temper. 'I lately had under my care an unfortunate gentleman, whose history has left a lasting impression on my mind: his general health was good, and the eye most favourable for operation, but, unfortunately, my patient possessed a most irritable temper; no sooner was the operation over than the bandages were torn off, all rules and treatment set at defiance, and of course the eye was lost. It is seldom that we meet with patients of this kind; and our best chance of obtaining information on the subject is through their usual medical attendant or friends, it is evidently necessary to make inquiries on these matters. It is also well to allow our patients to settle any business they may have in hand, so as to be able to give themselves up entirely to our bidding during, and after, the operation.

and make what provision we can.

PREPARATION,

PREPARATION OF THE PATIENT.—As I have above stated, the immediate preparation on the part of the patient will depend upon whether we are going to administer ether while operating or not; if not, the less we interfere with his usual habits, the better.

in case of ether.

Ether.—If we propose giving ether or chloroform, it is well to prescribe a dose of castor oil, or some other purgative, two days before the operation, and the day immediately preceding it the patient should take no solid food after 1 P.M.; we should then endeavour to operate early the next morning, before he has tasted either liquid or solid food. If these precautions are followed out it is very seldom indeed that a patient will vomit after inhaling ether.

To prevent vomiting.

Objections to ether.

With regard to the advisability of administering ether during the various operations for extracting the lens. The principal arguments against its use are, that people have died under its influence, and that it is likely to be followed by vomiting. The first of the objections, if valid, is equally applicable to other operations, and is hardly tenable at the present day; and as to vomiting after ether, if the patient is previously prepared, it seldom occurs, and should vomiting take place, an elastic bandage secured over the eye immediately after the operation, prevents injurious consequences. I may add that a subcutaneous injection of morphia prior to the operation, will almost certainly prevent vomiting, if used in addition to the preparatory measures above described.

Advantages greatly preponderate.

On the other hand it may be urged, that during extraction it is most important to have the patient absolutely passive and free from pain, and this anaesthetics secure, rendering the proceeding comparatively easy, and increasing the chance of success, particularly if the operator is young at his work; and lastly, it saves the patient some suffering and anxiety.

Anæsthesia should be complete.

Upon one point I would strongly insist, it is this—that the patient should be rendered absolutely and completely insensible; both sensation and reflex action must be totally in abeyance during the time we are operating, otherwise it were far better to leave anæsthetics alone. Unless I have an assistant with me who is in the habit of administering ether, I very much prefer giving it myself, and then proceeding to operate; there is nothing so fidgeting as seeing an assistant turning to you with a diffident air, as though to inquire if you wished any more ether given, or as if seeking to know whether all were safe with the patient; under these circumstances it is better to take the matter in hand oneself.

Disapproved by some.

Before closing these remarks on anæsthetics, I am bound to observe, that some of our most able surgeons seem hardly to approve of them. It may be that these gentlemen have had such vast experience, that they do not stand in need of the aid which ether certainly affords the operator, and doubtless after long practice one feels that in many cases better success may be obtained in removing a cataract without the aid of anæsthetics; nevertheless to surgeons who have not the wards of an ophthalmic hospital at their command, I can say with confidence, operate when your patient is fully under the influence of chloroform, and then, with ordinary care and knowledge, your success will be great; abstain from giving chloroform, and you may spoil many eyes before you can attain the like happy results.

Invaluable to less skilful operators.

I may now proceed to describe the operations employed for the cure of cataract, and I shall subsequently make a few general remarks upon the applicability of the various operations to different cases.

OPERATIONS.

(*See selection of an operation*, p. 504.)

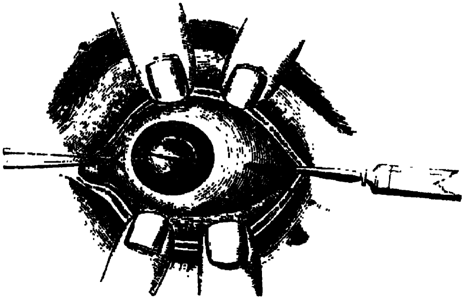
RECLINATION OR SCLERONIXIS.

DEPRESSION OR RECLINATION OF THE LENS.—The instrument required for the operation is a fine needle having its free extremity flattened and slightly curved.

General arrangements. The pupil having been dilated with atropine, the patient is to be seated on a low chair facing a window, so that the light may fall upon the eye to be operated on. The other eye being covered, and the eyelids of the eye to be operated on being kept open by means of a spring speculum, the patient's head is to be secured by an assistant, and the surgeon either standing or sitting in front of his patient proceeds to perform the operation.

Operation described. Supposing the left eye is to be operated on, the surgeon, taking the curved needle in his right hand, as he would a writing pen, should rest his fourth finger on the patient's temple, and run the point of the instrument through the sclerotic, at about a line from the circumference of the cornea, a little below the level of the horizontal diameter of the pupil; then thrusting the needle onwards, its convexity being turned towards the iris, the concavity is to be pushed against the summit of the crystalline, so as to force the lens downwards; the needle is then to be passed round the lens, breaking through the suspensory ligament; and lastly, its curved point is to be drawn across the anterior surface of the lens, so as freely to rupture its capsule, after which the lens is to be thrust backwards into the vitreous (Fig. 35), leaving the pupil clear and vision distinct. The needle may then be withdrawn from the eye, taking care to keep its sharp point turned away from the iris.

FIG. 35.



Ligament and capsule torn.

Lens depressed.

The only after-treatment necessary will be to close the eye for a few days with a pad and bandage. If any inflammatory or other complications occur, they must be treated upon the principles which I shall describe more fully when speaking of extraction of the lens by the flap operation.

OPERATION OF SOLUTION.

Directions.

THE OPERATION OF SOLUTION OR ABSORPTION.—The pupil having been fully dilated with atropine, and the patient laid on his back on a convenient couch, in front of a good light, the eyelids are to be separated with a stop-speculum, and the surgeon, standing or sitting behind his patient's head, passes a needle rather obliquely through the cornea at a point just within the position of the fully dilated pupil, puncturing the centre of the anterior capsule and cortical substance of the lens. No pressure should be exercised on the lens, or we may thrust it backwards into the vitreous chamber; this may be avoided by using the needle as a drill, rotating its handle gently, so as to bore a hole through the capsule and into the lens. As the needle is being withdrawn from the lens, the capsule may be torn open to about the extent of the undilated pupil.

Central perforation of capsule and cortex.

"Drilling."

The size of the opening thus made in the capsule must, however, depend upon the nature of its contents: if fluid, we may freely incise the capsule, and allow the soft lenticular matter to escape into the anterior chamber; but as a general rule, we cannot be too cautious in lacerating the capsule; it is far better to have to repeat the operation than to do too much at one time.

Avoid doing too much at once.

In the majority of cases, the needle will have to be used as above described several times, at intervals varying from a month to six weeks; but it may be laid down as a rule, that so long as the eye remains at all irritable after one operation, a second operation should not be attempted: among persons advanced in life, it frequently takes a year before the whole of the lens is absorbed. At each fresh operation the needle may be more deeply drilled into the lens; but as I have before remarked, we can hardly exercise too much caution in these cases; for if any of the lens substance escapes through the opening we have made in the capsule, and attaches itself to the iris, it may set up violent inflammation, rendering it necessary for us to take away the

The operation must be repeated.

Absorption tedious.

crystalline at once, or it is just possible we may succeed in introducing a small scoop through a wound in the cornea, and removing the offending particle from the eye.

If inflammation occurs, remove the lens.

I do not think it advisable in such cases to attempt a palliative plan of treatment for more than a few days; if our efforts to stop the inflammatory action, by the removal of the source of irritation with a small scoop, and subsequently by the frequent instillation of atropine, prove unavailing, we should proceed at once to remove the lens.

After-treatment.

Provided no complications occur, the after-treatment of an ordinary needle operation is simple enough. As a matter of precaution, the eyes had better be closed for a few days, and the patient placed in a dark room; the pupil of the eye operated on should always be kept fully dilated with atropine, and if no irritation occurs, the patient may be allowed to go about as usual in four or five days after the operation, keeping the eye closed, however, and the pupil dilated with atropine for a fortnight after the operation.

SUCTION OPERATION.

Accessory to the last.

THE SUCTION OPERATION.—This proceeding may be employed as an adjunct to the needle operation; that is, the capsule must first be freely opened, and the aqueous allowed to gain access to the lens, which rapidly undergoes degenerative changes, and after an interval of a few days may be removed with a Teale's suction instrument,* or with a Bowman's syringe.

Directions for using the syringe.

The instrument is to be used as follows:—The pupil being well dilated, a puncture is to be made in the cornea with a broad needle, opposite the fully dilated pupil, the needle should be thrust obliquely through the cornea, and the opening must be sufficiently large to admit the entrance of the nozzle of the suction instrument; the capsule having been freely divided, the curette must be gently buried in the opaque matter of the lens, our object being to break up the lens as far as possible without in any way displacing or irritating any of the surrounding structures. The nozzle of the suction syringe is then to be passed into the soft lenticular matter, and the piston being gently raised, the lens substance is sucked into the syringe so long as any opaque matter comes forward into the pupil. Care must be taken to keep the open end of the syringe well away from the iris, otherwise the iris may be drawn into the instrument and get bruised or injured.

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* *Ophthalmic Hospital Reports*, vol. iv. p. 197.

Avoid the iris.

No delay necessary in fluid cataract.

In cases of fluid or very soft cataract, there will be no necessity for waiting for a few days after the capsule has been opened, but the wound in the cornea having been then and there enlarged, the suction instrument is to be introduced, and the opaque matter removed as above described.

THE FLAP OPERATION.

Chloroform should be given.

EXTRACTION OF THE LENS BY THE FLAP OPERATION.—I have already stated my convictions as to the advisability of administering anæsthetics in operating by flap-extraction for the removal of an opaque lens.

1st *Stage.*

1*st Stage.*—The employment or rejection of ether makes some little difference in the manipulation necessary in the first stage of the operation, for no one operating with the patient under the influence of ether would think of making his section without first having fixed the eye to be operated on, by means of a pair of forceps; whereas if anæsthetics are not given, I think it is better not to attempt to fix the eye in this way, as the proceeding causes the patient a good deal of pain, and may make him strain more than is desirable while we are making the section in the cornea. I shall therefore describe the operation—first, supposing our patient to be under the influence of chloroform; and secondly, without its administration. I would premise that we are about to operate on the right eye, and by the upper section. The pupil of the eye to be operated on should be previously dilated with atropine.

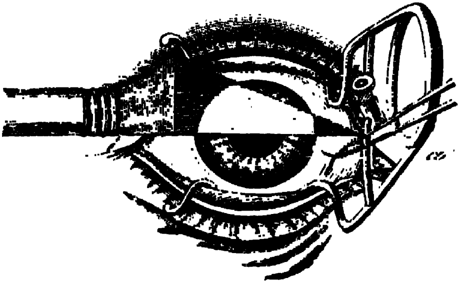
I. Directions for operating under chloroform.

1. Supposing the patient to be fully under the influence of ether, and laid on his back upon a convenient couch, with his head slightly raised and facing a clear bright light, which should fall obliquely on his face, and not from above, otherwise the surgeon, in bending over his work, will throw a deep shadow upon the patient's eye, which will prevent him from clearly seeing any flakes of lenticular matter or capsule left in the eye after the removal of the lens. A stop-speculum should be adjusted as represented in Fig. 36, the end of the instrument, *a*, resting against

Preliminary arrangements.

the nose. The surgeon, standing behind his patient, with the left hand seizes a fold of the inner and lower part of the conjunctiva, near the cornea, with a pair of toothed forceps, so as to steady the globe of the eye. I think it is better to fix the eye from the point mentioned, rather than from below the cornea, because the forceps can be used effectively under these circumstances to resist the eye from turning inwards as the knife is being passed through the cornea; it tends, in fact, to secure the line through which the knife passes in transfixing the eye, a matter of the greatest importance in this operation. The eyeball having been fixed as above described, be quite certain that your patient is fully under the influence of ether. The surgeon then holding the cataract-knife in the right hand as he would a pen in writing, the little or ring finger being placed against the patient's temple, so as to support and steady the hand.

FIG. 36.



Making the corneal section.

The point of the knife is then to be passed through the cornea near the extremity of its horizontal diameter, and about a quarter of a line from its margin, so as to be fairly within the structure of the cornea; the blade, when once introduced, is to be thrust steadily across the anterior chamber, until its point again pierces the cornea opposite its entrance, and at an equal distance from the margin. The same movement is to be continued, the blade being kept absolutely parallel with the iris, so as to fill the wound in the cornea, and prevent the aqueous from escaping, until the counter-opening in the cornea has been completed. The knife having been pushed onwards almost up to its heel (see Fig. 36), a small bridge of the cornea will still remain undivided; the surgeon now lets go his hold of the conjunctiva with the toothed forceps, and turning the edge of the knife a little forwards, divides the remainder of the corneal flap as he withdraws the instrument from the eye, so that the last portion of the cornea is cut through by a movement from within outwards, instead of from without inwards.

The flap completed in withdrawing the knife.

The section of the cornea having been completed, we must remove the stop speculum, and allow the lids to close; this finishes the first stage of the operation.

II. When chloroform is not used.

II. Supposing we do not wish to administer anæsthetics, the manipulation above described will have to be somewhat modified. The position of the patient is the same as before, but the stop speculum had better not be used; and if we wish to fix the globe with forceps, they must be handed over to an assistant, who should seize a fold of the conjunctiva near the lower part of the cornea. The surgeon, standing behind the patient, raises the upper lid with the fore and middle fingers of the left hand (the right eye being operated on), and gently rests the ring and little fingers against the upper and inner part of the sclerotic, so as to steady the eyeball. The section of the cornea and the further steps of the proceeding, are precisely similar, whether ether is administered or not.

Manipulation different.

The same section to be made.

It may happen that the surgeon does not think it necessary to make use of the fixing forceps, in which case his assistant simply everts the lower lid, drawing it well downwards, and fixing it against the malar bone, so that no pressure may be exerted on the globe of the eye, but I need hardly repeat the remark I have already made, that anæsthetics, the fixing forceps, and a stop speculum, are of great use in enabling us to make a satisfactory opening in the cornea, upon which proceeding, the success of the operation in a very great measure depends.

2nd Stage. Lacerating the capsule.

2nd Stage of the Operation.—This consists in lacerating the capsule of the lens, which may be done with a curved needle or a cystitome. It may be necessary at this stage of the proceeding, if the patient is under chloroform, to draw the eye slightly downwards with the fixing forceps, or, if sensible, to make him look toward his feet; the cystitome is then to be introduced into the anterior chamber, with its convexity downwards, so as to avoid wounding the iris. When opposite the pupil, the handle of the instrument should be rotated, and its point made to tear open the capsule by two or three incisions. The instrument is then to be withdrawn from the eye, and the lids allowed to close.

Avoid the iris.

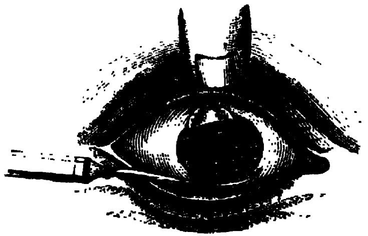
3rd Stage.—The third stage of the operation consists in removing the lens. The concavity of the curette is to be laid against the lower part of the sclerotic, and slight pressure made with it upon the globe; at the same time the point of the forefinger of the left hand is to be placed on the sclerotic, just above the section; by careful pressure, first with the curette and then with the point of the finger, the upper edge of the lens slowly turns forwards, passes through the pupil, and gradually protrudes through the incision in the cornea (Fig. 37). The pressure is now to be diminished, the lens being completely extruded by the elasticity of the tissues compressing it; and it may be coaxed on if necessary by inserting the curette into the wound, and exerting a slight degree of traction force on the lens, thus helping it onwards and out of the eye.

3rd Stage. **Removing the lens,**

by gently compressing the globe,

and slight traction.

FIG. 37.



The lens having been removed, the lids are to be closed, and after a few minutes again opened, and the eye carefully examined; any small particles of lenticular matter which may be seen in the anterior chamber should, if possible, be removed with the curette. The edges of the flap are then to be adjusted and the lids closed, a compress and bandage being at once applied over both eyes.

Remove fragments.

Close lids.

Accidents during the Operation.—Before considering the after-treatment to be followed in cases of flap extraction, I may advert to one or two of the most common mishaps that may occur during the operation, and the best means of providing against, or overcoming them.

Accidents during flap extraction.

I think it always very advisable to dilate the pupil fully with atropine before attempting to operate by a flap extraction. If the pupil does not dilate fully under the influence of atropine, then I strongly recommend that Graefe's operation should be performed in place of the proceeding above described. If it is determined to administer chloroform, let the patient be completely under its influence before we commence the operation.

Escape of aqueous.

If while the section through the cornea is being made the aqueous escapes, the iris will very probably protrude before the edge of the knife. Under these circumstances, the surgeon should make gentle pressure over the cornea with the point of his finger, so as to force the iris back behind the blade of the knife; but if this manipulation does not succeed, it is better to cut steadily on, and finish the section, cutting through a fold of iris at the same time. A knob of iris being thus shaved off, a bridge of this structure is often left between the hole thus made and the pupil; this strip of iris had better be divided before attempting to remove the lens.*

The iris may be wounded.

Enlarge too small a section.

If the section in the cornea is too small to allow the easy egress of the lens from the eye, do not try to force the lens through this insufficient opening; any such endeavour will lead to irreparable damage in at least fifty per cent. of the cases in which you attempt it, and in many others it will altogether fail to effect the object in view, the vitreous rather than the lens being squeezed out of the eye. Under these circumstances, supposing the patient not to be under the influence of chloroform, both he and the surgeon will have to exercise all the patience at their command, the latter endeavouring to enlarge the opening in the cornea by means of a pair of blunt-pointed scissors, the incision being carried downwards, so as to leave an ample opening through which the lens may escape.

Escape of vitreous before the lens.

Very gentle pressure should be made with the curette on the globe of the eye, so that in squeezing out the lens we may not press out a quantity of the vitreous at the same time. If any of the vitreous escapes before the lens, we should at once cease all pressure on the globe of the eye, and a scoop or a sharp hook may be passed through the wound, and the lens gently withdrawn from the eye.

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* Lawrence on "Diseases of the Eye," p. 627.

It sometimes happens that on making pressure upon the eye, the lens does not readily present itself in the pupil, in consequence of our not having sufficiently lacerated the capsule, in which case the cystotome must be re-introduced, and the capsule fully torn open. In most of these cases, however, it is an insufficient section in the cornea, and not the capsule of the lens, which is at fault.

Loss of vitreous after.

But supposing that at the moment the lens escapes through the opening in the cornea, a gush of vitreous follows, the eyelids must be at once closed, and a compress and bandage applied over both eyes. I do not believe that the loss of a small quantity of vitreous from the eye is a matter of consequence, and even a fourth of the vitreous may be lost, and yet the patient make a very good recovery;* nevertheless authorities of repute declare that accidents of this kind are to be carefully avoided, for loss of vitreous they think likely to be followed by irido-choroiditis, or even by detachment of the retina.

Prolapse of iris.

Replace if possible.

After the section has been completed, if, on opening the eyelids we find that a portion of the iris is engaged in, or prolapsing through the wound, we should at once endeavour, by means of a gentle rotatory motion of the point of the finger over the closed eyelid, to return the prolapsed iris into the anterior chamber.

Iridectomy.

If this method does not succeed, the best plan we can adopt is to perform iridectomy, removing the superior section of the iris. We may save an eye by this proceeding when all other means of treatment would fail. If, however, the patient has been rendered perfectly insensible with chloroform, there will be far less chance of a prolapse of the iris taking place than if he is straining, which is almost sure to happen towards the close of the operation if chloroform is not employed.

Prevented by chloroform.

Guard against reflection of the flap.

The extraction having been completed, care must be taken in closing the upper lid, otherwise the corneal flap may be turned backwards. To prevent this, some of the cilia should be taken hold of, and the upper eyelid gently drawn away from the globe as the lid is being closed; the eye must then on no account be again opened.

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* Lawrence on "Diseases of the Eye," p. 627.

The After-treatment of Flap extraction.—This should be directed in the first place towards keeping the edges of the wound in the cornea in accurate apposition, so that it may unite by the first intention; consequently, during thirty-six hours after this operation, the eye and the patient must be kept absolutely at rest. The former of these objects may be secured by applying a compress and bandage carefully over both eyes, and the second, by keeping the patient in bed, and everything about him as quiet as practicable.

Promote union by rest.

Immediately after the operation a little cold cream may be smeared over the eyelids, and before the patient rises from the operating table or bed, a piece of soft linen is to be laid over the closed eyelids of both eyes, and two light pads of cotton wool are placed over the linen, and the whole secured in position by means of a gauze bandage, so as to keep the eyes at perfect rest; if all goes on well, the bandage need not be removed for thirty-six hours. I apply the bandage very lightly, and with the sole object of keeping the eye at rest, and the edges of the corneal section in apposition till they have united.

Apply a compress and bandage.

The bandage having been adjusted on the operating-table, the patient must be conveyed to a bed, and directed to lie as much as possible on his back for the first few hours after the operation; he may then be allowed to turn on either side, but not to raise his head off the pillow, cough, or use any straining effort, and by no means to disturb the bandages. If the eye is bandaged in this way there is no necessity, and in fact it is not advisable, to keep the patient in a dark room. If there is much pain in the eye towards the evening after the operation has been performed, the compress must be removed for an hour or so, and the eye fomented with poppy-head fomentations; the surgeon should under these circumstances remain with his patient until the pain has subsided. Together with the fomentation a drop or two of a strong solution of atropine should be dropped into the eye, and then the elastic bandage without the compress may be applied, and the patient may soon fall off to sleep. A dose of morphia also may be given. There will

Morphia if there is pain.

necessarily be some uneasiness in the eye after the operation, but this is to be expected.

Liquid food.

With regard to diet, the patient may from the day of the operation have chicken soup, milk, or other fluids which can be poured into his mouth with a feeding cup; it is of importance not to allow him to rise from his bed, or chew any hard substance during the first twenty-four hours after the operation.

Usual diet after two days.

Stimulants if required.

Two days having passed away from the time of the operation, we may allow our patient more liberty; he may sit up and begin to take solid food; in fact, if all has gone on well, he may now return to his usual dietary, and in some cases beer or wine may be taken, in others it is necessary to abstain from stimulants until the patient can move about a little. On this subject Mr Dixon remarks—"Independently of prolapsus iridis, non-union of the corneal wound results from the same cause which prevents the union of a flesh wound, or of a broken bone—namely, the depression of the patient's nutritive functions below the proper standard of vigour. To keep an old and feeble person upon 'slops' for several days after extraction, for fear inflammation should set in, is surely contrary to common sense, and to all analogy in sound surgical practice."*

State of the lids a guide to that of the eye.

If at the expiration of thirty-six hours we remove the bandage, and find the eyelids of the eye operated on of a natural colour, not swollen, and no purulent discharge escaping from between them, the patient being free from pain, we may be almost sure that all is going on well. The pad and bandage must be again applied. Any unnecessary opening of the lids, in order to ascertain the amount of vision the patient possesses, is most injudicious.

Look at the eye after three days.

May be used in a fortnight.

After three days, we may gently open the eye, and look at the cornea and the state of the pupil; but the compress must be worn for the first five days after the operation, and then a bandage without a compress may be employed for three days more, and subsequently, if all is well, a shade may be substituted for the bandage. The patient must be kept in his room for some fourteen days, after which he can generally bear the light, and may be allowed to use his eye. A month having expired, we may order our patient suitable convex glasses, without which, I need hardly say, he will not obtain the full advantages which the removal of the opaque lens is capable of affording.

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* Dixon "On Diseases of the Eye," p. 325.

Accidents after the operation. *Accidents following the Operation.*—If some thirty-six hours after the operation, the patient complains of considerable pain in the eye, without any apparent cause, we must remove the bandage, and may either give a full dose of morphia, or inject a solution of morphia beneath the skin of the temple. A cold compress over the eye may be useful in these cases, provided the patient is not subject to rheumatism or gout, in which case warm poppy-head fomentations may be found soothing, and a light bandage should afterwards be applied over the eye. A dose of castor-oil is sometimes beneficial under these circumstances.

Pain.

Remedies.

Diffuse suppurative keratitis, Supposing the patient, within two days of the operation, suffers from considerable pain in the eye, and on opening the bandage we find the lids puffy and swollen, with a muco-purulent discharge oozing from between them, we shall have good reason to fear that suppuration of the cornea has set in, and we should at once examine the eye. If diffuse keratitis has begun, the conjunctiva will be found chemosed, the corneal flap may appear swollen and opaque, the edges of the wound infiltrated with pus, and the whole cornea hazy if not opaque; this state of things is utterly hopeless, the disease in all probability having commenced in the iris.

a hopeless' condition.

Partial keratitis. It may be, however, that the suppurative action is limited to the part of the cornea included in the flap, in which case we may still hope to save the lower part. A strong solution of atropine should be applied to the eye every second hour, hot compresses must be employed for two or three hours night and morning, and in the meantime steady pressure must be made upon the eye by means of the compress and bandage. Full doses of morphia should be given, so as to relieve the pain and irritation from which the patient suffers, and in robust and healthy patients two leeches may with great advantage be applied to the temple over the affected eye for three consecutive days; in weakly subjects large and repeated doses of the tinctura ferri muriatis and chlorate of potash are sometimes useful; and last but not least, we may have to administer port wine and beef-tea; but do what we will, we shall

Treatment.

Atropine.

Compresses.

Morphia.

Stimulants.

seldom succeed in saving an eye under these circumstances.

Subacute suppurative keratitis.

Employ warmth and stimulants.

Among the lower classes we not unfrequently find subacute suppurative keratitis commencing in hyperaction in the iris, following flap extraction. Within thirty-six hours of the operation, on opening the bandage, we notice some muco-purulent discharge oozing from between the lids; the patient probably complains of little or no pain in the eye, and the eyelids are not swollen, but on everting them the conjunctiva is found to be œdematous, and the cornea hazy, the pupil filled perhaps with yellowish lymph, and the upper section of the iris presenting spots of a similar kind on its surface; the edges of the wound are gaping open, and not the slightest sign of action or an attempt at reparation is apparent in the parts. Under these circumstances, we must endeavour by means of hot bandages, a firm compress, stimulants and nourishment, to excite nature to a reparative effort; but do what we will she is generally incapable of responding to our call, and necrosis of the cornea follows.

Prolapse of the iris.

During first week.

Another danger which we have to fear after extraction is, that a prolapse of the iris may occur. This accident may take place at any time within eight days from the operation, as the wound in the cornea will not have thoroughly healed until the first week is over, and of course, till then, the iris may at any moment be protruded through the section; a slight straining effort, such as a cough or sneezing, may be quite sufficient to produce this result.

Symptoms.

A prolapse having taken place, the patient will experience increased irritation and pain in the eye; the lids become slightly swollen, and a muco-purulent discharge is observed on the compress, or at the inner corner of the eye. On opening the lids, the cornea appears bright and clear, but the lips of the wound are more or less gaping, and a portion of the iris may be seen protruding from between them.

Apply arg. nit. and compress.

Under these circumstances, the prolapsed portion of the iris should be touched with a pencil of caustic, and a firm compress and bandage applied over the closed eyelids, and kept there for twelve hours; the bandage may then be removed, and the lids bathed with a little tepid water, but not opened. Some cold cream having been smeared over them, the compress and bandage should be reapplied. This treatment may be continued for a month, the nitrate of silver being employed from time to time. But if after this period the prolapse is as prominent as before, it will be advisable to incise it with a broad needle; the aqueous behind escapes, and the prolapse contracts; the compress and bandage must then be reapplied. This little operation may have to be repeated every other day or so, until the prolapse has disappeared.

Incise the prolapse,

If this treatment does not succeed, the prolapse may subsequently be snipped off with a pair of curved scissors.

or remove it.

If on opening the eyelids soon after the operation we find a large and widely distended section with a considerable portion of the iris protruding through it, we must at once excise the prolapse with a pair of scissors, and then closing the lid carefully bandage up the eye. Considering the steps taken in flap extraction, it is evident, especially in large hard senile cataracts, that the iris unless fully dilated with atropine must be more or less pressed upon and bruised, as the lens is forced through the pupil and out of the section in the cornea; consequently we might expect to meet with cases of iritis after this proceeding, and such is in fact one of the complications we have to contend with; cases of apparent sloughing of the cornea not unfrequently commence in inflammation of the iris after flap extraction: but by far the most common cause of iritis is occasioned by fragments of the capsule and cortical matter of the lens being torn off, and attaching themselves to the iris set up considerable irritation and inflammation in the part. Moreover, no one can have watched disease involving the posterior layer of the cornea, without observing its liability to spread to the iris; and the epithelium of the posterior elastic lamina is often scraped off in the passage of the lens from the eye.

Iritis following extraction;

Iritis may come on within the first six days after an extraction; it may commence by symptoms of violent and rapidly destructive inflammation in the part, involving also the cornea; on the other hand, everything may seem to have been going on well until about the fifth day; the patient then begins to complain of pain in the eye, and on examining it we may discover all the symptoms and appearances of iritis: it is unneces-

About the sixth day.

sary for me to recapitulate these here, as they are fully described in the section treating of iritis.

Treatment. **Atropine.** **Remove lenticular matter.** **Iridectomy; When to be resorted to.**

With regard to treatment, we should apply two leeches to the temple over the affected eye for three consecutive days, but atropine will be our mainstay, and must be freely employed. But if small particles of lenticular matter are seen attached to the iris, or lodged between it and the cornea, and if the pupil will not dilate under the influence of atropine, it is well to give the patient chloroform, and making an opening in the cornea, to remove all the lenticular matter we can see with a scoop. If we are in any doubt as to there being lenticular matter behind the iris, which we cannot remove, we hesitate to perform an iridectomy; excision of the iris is, however, sometimes followed by favourable results under these circumstances. The question arises as to the advisability of attempting to reduce the iritis, and subsequently performing an iridectomy if the pupil is closed. I think, if on examining the patient's eye on the third day, we find the cornea hazy, pupil dull if not closed with lymph, iris refusing to dilate under atropine, and the patient in great pain, we may, having placed the patient under chloroform, excise a fourth of the iris; but if the case has been allowed to run on for twelve or fifteen days I would recommend its being treated simply for iritis, and an iridectomy being performed when all active symptoms of inflammation have passed away; or an incision through the closed pupil, may under these circumstances be all that is necessary; but the operation had better not be performed until hyperaction has apparently ceased in the iris and parts around it.

Atropine.

Supposing, however, that on opening the eye on the third day after the operation we find a discharge from the conjunctiva, the cornea hazy and pupil occupied by lymph, we must try the effect of constant instillation of atropine, and smearing the extract of belladonna and atropine over the patient's brow.. The atropine should be used in this way for twenty-four hours, and should the pupil dilate under its influence we may trust to time and treatment, taking care to keep the eye at perfect rest with a pad and bandage.

Rupture of retinal vessels;

The most dangerous complication that can occur after extraction of the lens, is the rupture of some of the vessels of the retina or choroid. The operation has, perhaps, been an easy one, but within a few minutes of the removal of the lens, the patient complains of great pain in the eye, and to our dismay, on opening the lids, we find the anterior chamber not only full of blood, but blood oozing out through the wound in the cornea.

a hopeless case.

A case of this kind is utterly hopeless: we can do no more than apply ice over the eye, so as to check the bleeding, but as an organ of vision the eye is completely destroyed, and can never recover. This accident may occur some hours after the operation, if the patient sneezes or coughs violently.

MODIFICATIONS OF FLAP EXTRACTION.

MODIFICATIONS OF FLAP EXTRACTION.—I may now proceed to consider some of the principal modifications of the flap operation which have been advocated within the last few years.

Iridectomy; some weeks before extraction.

Objections.

Iridectomy in Extraction.—It has been proposed to excise a portion of the iris some weeks before the extraction. In the first instance iridectomy is to be practised on the upper section of the iris, and after six weeks or two months the lens is to be removed as usual by means of the flap operation. Against this proceeding it is advanced that few patients will consent to undergo two operations of this kind if it is possible to do all that is necessary at once.

Iridectomy after extraction.

Iridectomy has been practised immediately after the extraction of the lens with success by Professor Jacobson; he removes the lens in the first instance through a flap formed from the lower part of the cornea, and he then excises a fourth of the corresponding section of the iris.

Immediately before removal.

Lastly, an iridectomy may with the greatest advantage be made immediately before the removal of the lens; the section being an upper one, the superior fourth of the iris is excised, and the lens removed as usual. In old subjects, whose pupils do not dilate under the influence of atropine, and, particularly if adhesions exist between the iris and capsule, an iridectomy, made at the time of the operation, vastly lessens the dangers to which such an eye is exposed from flap extraction.

Removal of lens in its capsule.

The Removal of the Lens in its Capsule.—This is by no means a new method of extracting the lens, having been practised with varying success since 1778, and lately strongly advocated by Dr. Pagenstecher and M. Sperino; and I certainly agree with these surgeons, believing that if it were possible in every case upon which we operate to remove the lens in its capsule, without damaging the other structures of the eye, we should have reached perfection in the extraction of cataracts.

Prevents capsular cataract and iritis.

The object we have in view in the operation now under consideration is to remove the lens without opening its capsule. The advantages it offers are, that no capsular cataract can possibly form, and there is no chance of any soft lenticular matter being left clinging to the iris, and setting up irritation and inflammation in that delicate structure: and the greater my experience in these matters, the more convinced I am that most of our failures in extraction are due to the fact of soft lenticular matter and capsule being left in the eye after the removal of the lens.

The section in sclerotic.

Iridectomy.

Gentle pressure,

or traction.

Atropine having been applied so as fully to dilate the pupil, the patient is to be laid on his back. The surgeon, standing by the side of his patient, applies the stop-speculum; and the eye, being fixed with a pair of forceps, an upward linear incision is to be made through the *sclerotic*, immediately beyond the margin of the cornea, the same precautions being taken in making the section as I have already described in the case of ordinary flap extraction. A portion of the iris is then to be excised, and gentle pressure exercised with the curette upon the lower part of the sclerotic, and at the same time counter-pressure is to be made with the point of the fingers upon the upper part of the eyeball. In this way the lens in its capsule may be gently forced out of the eye. If the lens is not readily displaced upon slight pressure being made on the globe of the eye, a shallow round curette may be inserted behind the lens, and a gentle traction exerted on the lens, so as to start it from its position.

The section must be ample.

In making the flap, we must keep slightly external to the margin of the cornea, so as to leave as large an opening as possible, through which the lens may escape, its bulk, when contained within the capsule, being considerable.

Results favourable.

This operation is no doubt a very valuable one, and often leads to most favourable results. Even supposing there is a difficulty in extracting the lens in its capsule, the latter may be opened, and the operation completed as in ordinary flap extraction; in fact, it will be advisable to resort to this proceeding, unless the lens and capsule pass through the section in the cornea upon slight pressure being made on the eyeball: any extra force is likely to squeeze out a considerable quantity of the vitreous: and we cannot too strongly insist on the fact, that in extracting a cataract force must never be employed.

The operation which I have practised in a very large number of cases within the past few years, is a modification of the proceeding I have described in former editions of this work, under the heading of "modified linear extraction." I found that by making an incision through the extreme outer margin of the cornea, and then removing the lens with a scoop, that I seldom lost an eye from suppuration of the cornea—an accident, in spite of all our care, too common among the natives of Lower Bengal, if operated on by means of the ordinary flap extraction. I was always rather ~~indisposed~~ to iridectomy in extraction, upon the principle of not removing from the eye, or any other part of the body, any structure which could be retained without interfering with the result of the operation. And as I have before remarked, in addition to this objection to excising a part of the iris, it appeared very certain to me, that in cases in which the pupil dilated fully under the influence of atropine, the dangers which the eye ran in extracting the lens was not so much from bruising of the iris, as from leaving detached portions of lenticular matter and capsule in the eye; these loose organic substances in the eye, and the unjustifiable endeavours to force a lens through a section in the cornea too small to permit it to glide through, seemed to me the sources of many of my unsuccessful cases of extraction: and in order if possible to obviate these difficulties, and almost in ignorance of what was going on in other places, it would seem that I have settled down into performing an operation for extraction very similar in many respects to that practised by several other surgeons in Europe.

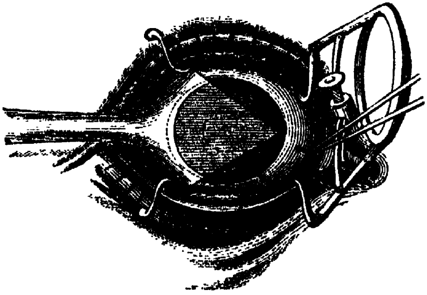
THE AUTHOR'S OPERATION without excision of iris.

The pupil having been kept widely dilated with atropine for two or three days before the operation, the patient is laid on his back, and placed under the influence of chloroform. The operator adjusts a stop-speculum.

Directions for making the section.

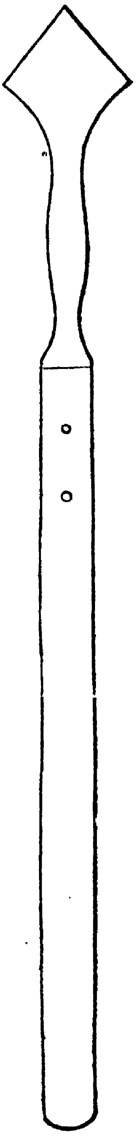
Supposing the right eye is to be operated upon, the surgeon standing behind his patient with a pair of fixing forceps, seizes a fold of the conjunctiva together with the tendon of the internal rectus, so as to have a steady, firm hold of the eyeball, and in the other hand takes a short and broad-bladed triangular knife (Fig. 38), and thrusts its point through the line of junction of the cornea and sclerotic, on the temporal side of the eye. The blade of the knife is to be passed steadily onwards nearly up to its heel (Fig. 39), so that the incision made through the sclerotic is at least half an inch long. The point of the lance-shaped knife, entering the eye at the junction of the cornea and sclerotic, it is evident that as the blade of the instrument is thrust into the anterior chamber, parallel to and in front of the iris, that the extremities of the incision will extend into the sclerotic.

FIG. 39.



Form of the knife.

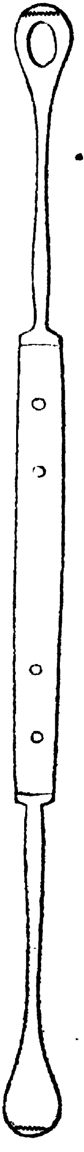
FIG. 38.



The knife is to be withdrawn very slowly from the eye, so as to prevent the sudden escape of the aqueous humour, which may cause the pupil to contract. The speculum and hold of the internal rectus being retained, the scoop (Fig. 40) is to be inserted

Extraction of the lens.

FIG. 40.

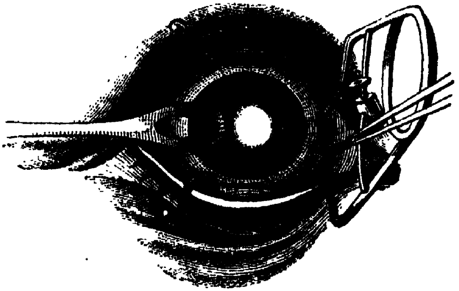


Manipulation with the scoop.

so far into the anterior chamber as to enable us to reach the margin of the pupil; the handle of the instrument being raised and its rounded extremity depressed, the latter evidently rests on the capsule of the lens, immediately within the margin of the pupil. The scoop is now to be slightly withdrawn, still keeping its extremity on the lens, but so as to draw open the pupil far enough to enable us to pass the scoop round the outer circumference and thus behind the lens (Fig. 41), the scoop being thrust onwards along the posterior capsule, until its bent and toothed extremity embraces the inner margin of the lens; in this way the lens comes to lie in the concavity of the scoop, and may be removed from the eye (Fig. 42), if possible without breaking the capsule. Should the capsule of the lens be ruptured, however, during the above-described manipulation, the bulk of the lens must still be drawn out of the eye by means of the scoop; and subsequently particles of lenticular matter remaining in the anterior chamber must be taken away.

Rupturing the capsule.

FIG. 41.



The lens may be removed in its capsule.

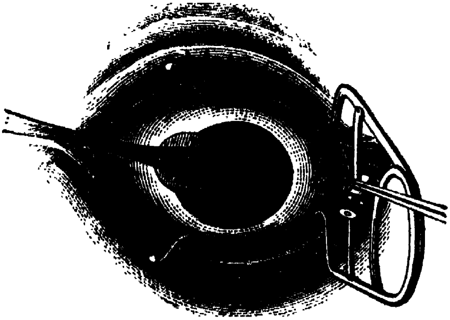
In performing this operation, my aim is to remove the lens in its capsule, particularly if there is much transparent cortical matter round the lens, which would escape detection at the time of the operation, and adhering to the iris, might excite inflammation of that part. Moreover, in cases of senile cataract, the capsule often adheres to the lens with considerable tenacity, and may therefore the more readily be removed with the lens.

After the lens has been taken away, I adjust a compress and bandage over both eyes, and the patient is removed to his bed.

Atropine to follow the operation.

Thirty-six hours after the operation, if there is pain in the eye I usually evert the lower lid, and drop a solution of atropine into the eye. If the pupil expands under the influence of the mydriatic, we need have no further apprehension as to the result of the case; but if the iris refuses to respond to atropine, we have to fear that iritis may supervene. I have been in the habit of performing the operation above described in instances of senile cataract, in which the pupil dilated very slowly, and never very fully under atropine, with, however, this important addition: after having made my incision into the eye, I excise a fourth of the external section of the iris, and then passing the scoop behind the lens, ease it out of the eye without dividing the capsule.

FIG. 42.



After-treatment as in flap extraction.

The After-treatment is to be carried out upon precisely the same principles as those I have indicated in instances of flap extraction; but these rules may be less rigorously enforced. The greater the care immediately after the operation, the less chance of subsequent evil.

With regard to the complications that may occur after this operation, I would refer the reader to the observations already made under the head of flap extraction; they are to be treated in precisely the same way, and I need not therefore reiterate the remarks I have already made on the subject.

LINEAR EXTRACTION.

LINEAR EXTRACTION.—The operation of linear extraction has undergone various modifications, and is now hardly to be recognised under its old name; it is, in fact, generally described as the Traction operation.

Gibson's operation

Gibson's Operation.—Linear extraction, as described by Mr. Gibson, is a proceeding which is seldom resorted to at present. It consists in dilating the pupil and lacerating the capsule with a needle, as if operating for solution—only the capsule must be more freely incised. The aqueous, in consequence, gains access to the lens, and renders its already degenerated fibres still softer. Some four or five days after the needle operation, an incision is to be made through the cornea, so as to allow of the introduction of a curette into the anterior chamber; the instrument being now turned edgeways, so as to open the wound in the cornea, the soft lenticular matter escapes, together with the aqueous, from the eye. It will be evident that this operation can only be employed in instances of soft cataract; and even then it is attended with considerable danger, in consequence of the irritation that may be set up from the pressure exerted by the swollen lens in the eye, or from small pieces of cortical matter which may be left attached to the iris.

only applicable to soft cataract.

The traction operation.

The Linear or Traction Operation, as described by Messrs. Bowman and Critchett, is performed as follows:[*] The patient having been laid on his back, and the stop-speculum introduced, the surgeon fixes the eyeball with one hand by means of a pair of toothed forceps: and, taking an iridectomy knife in the other, makes an opening through the corneo-sclerotic junction at its upper part.

The section.

The opening must occupy about a fourth of the circumference of the cornea, so as to allow the introduction of the scoop into the eye. In the case of a soft cataract, there will be no necessity to make quite so large an opening as this.

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[*] *Ophthalmic Hospital Reports,* vol. iv. p. 315.

Iridectomy.

The incision having been completed, a fold of iris is to be excised, as in iridectomy. Should there be any bleeding into the anterior chamber, the curette must be introduced between the lips of the incision and slightly pressed upon the sclerotic edge of the wound. At the same time, the tendon of the inferior rectus must be seized with a pair of forceps, and the eye gently pulled downwards, so as to cause just sufficient pressure to squeeze the blood out of the anterior chamber.

Management of hæmorrhage.

The capsule to be freely torn.

The capsule of the lens is then to be lacerated freely —if possible, as far as the suspensory ligament; but that structure should not be broken through, if it is possible to avoid doing so. If much transparent cortical substance surrounds the opaque part of the lens, Mr. Bowman inserts the point of the pricker into the lens-substance, and then slightly rotates the body of the lens on its antero-posterior axis, so as to loosen it from the capsule. If this is not done, the cataract is very apt to adhere to the capsule.

The lens removed with a scoop.

The lens is then to be removed with a scoop or traction instrument, which is to be introduced through the wound in the cornea, and passed gently onwards between the capsule and the nucleus of the lens. The lens having been secured by the scoop, the instrument is to be withdrawn from the eye, and with it the lens. Any small portions of lenticular matter, which may be left behind in the anterior chamber, are to be carefully removed with the scoop or the suction instrument, and the eye is then to be closed, and a compress and bandage applied over it.

V. Graefe's modification.

Von Graefe's Modified Linear Extraction.*—The patient having been placed under the influence of chloroform, the lids separated by an adjustable speculum and the eyeball drawn downwards by forceps applied immediately *below the cornea,* the operation is commenced.

Step I. The Incision.—The point of a long narrow-bladed knife, with the cutting edge directed upwards,

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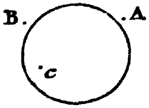
* *Ophthalmic Review*, vol. iii. p. 25.

1. Directions for making the section.

is inserted in the sclerotic, near the upper and outer portion of the cornea, at the point A (Fig. 43), so as to enter the anterior chamber as peripherally as possible. In order to widen the extent of the inner wound, the point should at first be directed downwards and inwards towards C, and then when the blade has advanced about 3½ lines into the anterior chamber, the point of the knife is to be directed up and along to B, where the counter puncture is to be made; great care must be taken that this point does not lie too far back in the sclerotic. Only when the knife has advanced fully three lines and a half within the visible portion of the anterior chamber should the handle be lowered, and the instrument directed along the scleral border on to B. As soon as the resistance to the point is felt to be overcome, showing the counter-puncture to be accomplished, whether the uplifted conjunctiva be transfixed or not, the knife must immediately be turned steeply forwards, the back of it being almost directed to the centre of the ideal sphere of the cornea, when the incision is to be continued in this plane: first, by boldly pushing the knife onwards, and then, after its length is exhausted, drawing it backwards. Should this latter movement, though generally sufficient, fail completely to divide the scleral border, the sawing manœuvre must to a less extent be repeated. As soon as the last bridge of the scleral border is cut through, the knife lies freely moveable under the uplifted conjunctiva, which, in order to avoid the formation of too long a flap (the proper height is 1½'''—2'''), must now be divided by a sawing movement horizontally forwards, or even forwards and downwards.

Fig. 43.



The Iridectomy.

Step II. The Iridectomy.—The holding forceps having been handed to an assistant, with a straight pair of iridectomy forceps, we lift the conjunctival flap of the prolapsed iris; and reflect it down over the cornea, when the prolapsed portion of iris appears perfectly bare. Hereupon, the prolapse of the iris is seized with the forceps at its central and most vaulted portion. It is gently pulled upon, so as to make it present a triangular shape, and excised at its base from one corner of the wound to the other, to which end usually two slight strokes of the scissors are required, care being taken that little tags of iris are not left involved in the angles of the wound. After excising the iris, we should direct our attention to the position of the sphincter papillæ, and if we find that its angles are curled upwards, or involved in the section, we should press them gently back with the curette, so that the sphincter comes to be in its normal position flat upon the capsule of the lens. If at this stage of the operation hæmorrhage takes place into the anterior chamber, the blood may be evacuated by pressing on the cornea with a soft sponge; in some instances it may be necessary to lift up the corneal flap, and squeeze the blood out of the anterior chamber by rubbing the lower lid on the cornea.

3. Lacerating the capsule.

Step III. Laceration of the Capsule.—The operator having resumed the fixing forceps, now with a cystitome properly bent, and which is armed with a fleam, divides the capsule freely by two or three successive rents, beginning from the lower edge of the pupil, and ascending successively along its nasal and temporal margins near to the upper equator of the lens.

4. Evacuation of the lens.

By simple pressure, if cortex is soft.

Step IV. Evacuation of the Lens.—The mode of evacuating the lens varies, according to the amount of soft surface matter. Where there is plenty of it, the delivery is, as a rule, effected without the introduction of any instrument, merely by external pressure. The back of a broad and moderately arched spoon is, close to the centre of the incision, gently pressed against the sclera, so that the wound is made to gape. Thus, cortical masses are caused to escape, and the vertex of the nucleus presents itself. In order to promote as much as possible the thorough exit of the latter, the back of the spoon is made to glide along the sclera; first, with an equable degree of pressure laterally towards the corners of the wound, and thereupon, withdrawing it from the wound, upwards with a continuous increase of pressure. If during these movements the diameter of the nucleus present itself, the pressure is more and more abated, and the delivery may be completed by applying the end of the spoon to the projecting edge of the nucleus.* If there be but a thin stratum of soft cortex, the recommended "slide manœuvre" may likewise be tried, but ought to be

By the use of a hook in harder forms.

abandoned as soon as we observe that during the lateral movements no presentation ensues. In this event, the hook must be resorted to, which in the case of hard cataract is required *ab initio*. The blunt hook which Von Graefe was in the habit of employing has the form represented in Fig. 44, and has its stem bent in such a manner as to enable it to be readily pushed under the nucleus. It is first laid flat on the opening made in the capsule: thereupon drawn back over the near edge of the nucleus, when, by a suitable elevation of the handle, it is brought in the direction of the posterior cortex, along which it is then pushed forward on the flat, until it has passed the posterior pole of the nucleus. The instrument is now between the fingers rotated around its axis, so that the plane of the curved extremity of the hook exchanges its horizontal for the vertical position; or should resistance be felt, an oblique one; and the nucleus, or as the case may be, the whole lens, is by a gentle traction carried towards the incision.

FIG. 44.

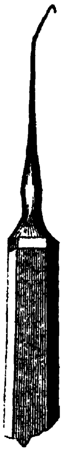
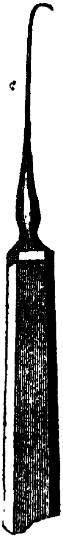


FIG. 45.



Modification.

Von Graefe more recently strongly advocated the removal of the lens by pressure on the lower portion of the cornea with a vulcanite curette. The eye being fixed by means of a pair of forceps holding a fold of conjunctiva below, and to the inner or outer side of the cornea, the curette is placed along the lower margin of the cornea, and pressure made backwards and upwards as in ordinary flap extraction, the same precautions being taken as I have already described when considering the older operation.

5. Removing cortical fragments.

Step V. Clearing of the Pupil, and Coaptation of the Wound.—Von Graefe adds, if, as happens in the majority of cases, after extraction of the nucleus, cortical masses remain, they must be evacuated by gentle pressure and friction, exercised with the finger-ends through the medium of the lids, and in accordance with the well-known rules for the same purpose observed in flap extraction. Only in exceptional cases may a small spoon be introduced for the removal of isolated cortical fragments, which may be partially adherent to the capsule. Very delicate coatings of the capsule, if their evacuation be difficult, are better left behind; but, on the whole, as complete a removal as possible of the cortex should be insisted on. Finally, the wound is to be cleared with forceps from any adherent iris, pigment, or coagula, and the conjunctival flap replaced in its proper position.

Closing the wound.

After-treatment.

Regarding the *after-treatment*, I may be brief. The usual compressive bandage must be applied, and first renewed five or six hours after the operation, afterwards twice (or even once) a day. In regard to light, the habitual cautions must be observed. Rest is to be recommended, but less rigorously than after flap extraction. If necessary, the patient may pass even the first days following the operation out of bed. Respecting the diet, everything may be allowed excepting stimulants and such aliments as require mastication. From the second day I apply atropine (usually twice a day), chiefly to prevent coalescence of the two corners of the sphincter with the capsule. Only where copious conjunctival secretion either existed before or became apparent after the operation, I defer the application. If anything untoward occurs, a cautious yet accurate examination (always by artificial light) must decide whether it originate from the wound, the cornea, the iris, or the capsular cells, when the proper measures have to be taken in accordance with the customary rules. With reference to the section, Mr. G. Lawson and other surgeons who have extensively practised Von Graefe's operation, advise that the line of incision should commence at a point corresponding to the upper edge of the pupil, the section being made entirely in the cornea; and that only a small piece of the central portion of the iris should be excised.

Less rigorous than in flap extraction.

LIEBREICH'S OPERATION FOR CATARACT.—The following is Mr. Liebreich's description of his operation:—

The incision of the cornea is to be made with the smallest possible Graefe's knife in the following manner.

Puncture and contra-puncture are made in the sclerotic about one millimetre beyond the cornea, the whole remaining incision passing with a very slight curve through the cornea, so that the centre of it is about one millimetre and a half distant from the margin of the cornea. This incision can be made upwards or downwards, with or without iridectomy, and the lens can be removed through it with or without the capsule.

If, as I now practise, the extraction is made downwards without iridectomy, the whole operation is reduced to the greatest simplicity, and does not require narcosis, assistance, elevator, or fixation; and only two instruments—namely, Graefe's knife, and one cystitome, with Daviel's spoon.*

Taylor's Operation for Cataract.—The special object of this operation is to extract the lens through a peripheral section of the iris without injuring the pupil.

The following is Mr. C. Bell Taylor's account of his operation:—

The instruments I employ are a pair of sharp forceps that pierce the sclerotic; a very light speculum (a modification of Von Graefe's); and two knives, a line in width, and bent at an angle similar to the ordinary iridectomy knife—one with a sharp point, the other with a blunt or bulbous extremity.

Having separated the lids with the speculum, the eye should be gently turned downwards with a pair of ordinary forceps in the operator's right hand. Having got the globe into a favourable position, it should be fixed by the sharp forceps at about the junction of the upper with the middle third of the cornea; the pointed knife is then entered in the corneo-sclerotic junction one or two lines from the forceps at the summit of the cornea, pushed well into the anterior chamber, and then with a gentle sawing motion carried along the summit until about one-third of the cornea has been incised. The capsule is then carefully divided with Von Graefe's cystitome, having been previously rendered tense, and the eyeball fixed with a pair of ordinary forceps. It is better to open the capsule at this stage, because bleeding from the wounded iris—and conjunctiva also—at a later period is apt to fill

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* *British Medical Journal*, Dec. 2, 1871.

the chamber and render this part of the operation obscure and difficult. The upper segment of the iris is then seized, and a small piece of the periphery only excised, the pupillary margin and portion of iris attached to it being left untouched and free in the anterior chamber; the lens is then extruded through the gap in the ordinary way, gliding behind the pupil, so that there is no stretching of the sphincter.

In this way I believe that I have secured all the advantages, in the way of safety and certainty, of an associated iridectomy (which I have already detailed), and at the same time attained that grand desideratum—a central and moveable pupil.

Choice of an operation.

Selection of an Operation.—We may now pass on to the consideration of the circumstances which would probably lead us, to select either one or other of the operations described for the removal of a cataract.

With regard to the operation of reclination, there can be no doubt that by far the majority of surgeons of the present day have discarded this proceeding altogether; nevertheless, Professor Quaglino, of Pavia, has lately been operating by reclination with success, and he thinks that we have abandoned this operation without good cause.[*] Professor Quaglino remarks, that the most permanent and brilliant results of depression are obtained in the case of cataracts which are either soft or cheesy in consistence, in the fluid ones among middle-aged people, and in those which occur in infancy. In hard, senile cataracts it may be adopted, but more exceptionally. Evidently, therefore, the best results follow in precisely those cases which succeed best either by linear extraction, the suction operation, or solution; and my own experience certainly leads me to prefer any one of these means of removing a cataract to that of reclination. I may, however, refer to the practice of other surgeons in this respect. Dr. J. T. C. Ross has probably had as much experience, and operated as often for reclination as most surgeons in India, and he tells me that fifty per cent. was above the average of cures

Recent revival of reclination.

Doubtful advantages.

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[*] A Clinical Lecture by Prof. A. Quaglino on Scleronixis: *Ophthalmic Review*, Oct. 1867, p. 374.

in his practice among patients such as those described by Professor Quaglino as presenting the most favourable conditions for reclination.

Danger of the operation.

The native Huckeems and Kobrages always operate for the cure of cataract in this way, and hardly a week passes that some of their patients are not seen at the Calcutta hospital, suffering from either inflammation of the choroid, or from retino-choroiditis. Here, at any rate, we have warning sufficient to prevent our resorting to this proceeding.

Advantages of solution.

The operation for solution of cataract is a most valuable one, but the great drawback to it is the length of time it often takes to cure a patient by this means; and the risk run from the contact of detached pieces of the lens resting on the iris, and exciting more or less inflammation in this delicate structure. Solution is, of course, most applicable to instances of soft cataract, occurring in persons under thirty-five years of age, or before the nucleus has fully formed. If in a case of this kind, the sight of one eye is almost destroyed by a cataract, and the other eye is beginning to get dim, most surgeons would select the operation of solution as being the one likely to yield the best results, the worst eye, of course, being operated on.

Too tedious for the poor.

This rule, however, is more applicable to the case of private patients than to those in hospital, because the latter class can ill afford the time necessary to complete the cure, particularly if they come from a distance, and cannot consequently attend as out-door patients. Nevertheless, I find from the Moorfields Hospital Reports, that in 1866, of three hundred and forty-one cataract cases operated on, not less than ninety-nine were treated by solution; this is a fair criterion of the high estimation in which the very able surgeons in charge of the Moorfields Hospital hold the operation. I cannot say that in my own practice I operate by solution in nearly the same proportion of cases, preferring, even in soft cataracts, to remove the lens in its capsule.*

V. Graefe's method in hard cataract;

In the majority of cataracts, however, the nucleus is hard and therefore effectually prevents our operating for solution; we have consequently to determine whether we perform the old flap extraction, Von Graefe's operation, or one of the modified forms of extraction which I have described. In coming to a conclusion upon this point we must take into consideration the circumstances of the patient. Among the low-feeding population of India we are very apt to get sloughing of the cornea, and I think, as a rule, less likely to have inflammation of the iris induced by a slight amount of injury than is the case amongst Europeans; nevertheless it may probably be laid down as a rule that in senile cataract it tends to success if a portion of the iris is excised immediately before the lens is taken out of the eye, as in Von Graefe's operation; in fact, the prevailing opinion among ophthalmic surgeons of the present day is that there is no operation which affords a patient affected with senile cataract a better hope of recovery than Von Graefe's method of removing the lens:* and I most certainly concur in this opinion, provided it is found that the patient's pupil does not fully and quickly dilate under the influence of atropine; but if the pupil does act thoroughly after atropine has been employed, I am of opinion that we should remove the lens in its capsule; at any rate I am not disposed to excise any portion of the iris if the pupil is well dilated and cannot thus hinder the passage of the lens from the eye.

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* "Contributions to Ophthalmic Therapeutics." By Robert Brudenell Carter. *Practitioner*, March, 1871.

and in cortical.

In the mixed or cortical cataract the majority of surgeons would prefer to operate by Von Graefe's proceeding rather than by modified linear extraction; nevertheless my own success has been so great in instances of this kind by the employment of the operation I have described at page 508, that I cannot but advise to give it a fair trial. In Europe, with the advantage of skilful assistants to help at the time of the operation, and good nurses to attend to the patient afterwards, we might prefer Graefe's operation in cases of cortical cataract, but in India we seldom have these advantages and have to depend mainly upon ourselves for success. We shall be called upon to operate very often on comparatively young people, say from forty-five to fifty years of age, and in instances of this

Or the author's modification.

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* "On Extraction of Cataract." By H. Wilson, St. Mark's Hospital, Dublin. *Dublin Quarterly Journal of Medical Science*, May, 1870.

description I have gained most satisfactory results by means of modified linear extraction, seldom finding it necessary in cases of this kind to excise a portion of the iris.

Mr. H. Cayley, of Calcutta, has lately written on this subject. He remarks that during the year 1874 (excluding cases of soft cataract) he operated on 135 cases of hard or mixed cataract: of these thirty-eight cases were operated on by Graefe's method, "twenty-nine were successful, leaving the hospital with good sight. This gives nearly 77 per cent. of cures." "The cases of Macnamara's operation gave the following results. The total number of cases was 97, of which 84, or nearly 87 per cent. were successful; in three cases iritis set in, from which the patients recovered with a fair amount of sight; in 53 of the 97 operations, the lens and capsule came out entire, and only one of these went wrong; this patient was suffering from chronic bronchitis, and a violent fit of coughing caused hæmorrhage into the vitreous chamber."*

Zonular cataract, operations for.

Iridectomy, again, may be useful in instances of zonular cataract, provided we find its centre opaque, and the outer part of the lens free from striæ or opaque dots. Under these circumstances we may fairly assume that the opacity in the lens will not advance, or if it make any progress that it will do so very slowly; and it will then be advisable, either by means of an iridodesis or an iridectomy, to open a passage for the rays of light to the retina, through the transparent part of the lens; it is evidently far better to leave the lens *in situ* if possible. But supposing that, from the presence of striæ and spots, together with increasing impairment of vision, we have evidence of advancing changes in the lens, it is then advisable to open the cornea by means of a linear extraction knife, and so to withdraw the lens from the eye with the help of a scoop.

Extraction of opaque membrane.

In cases where a soft cataract has in part become absorbed, leaving a deposit on the inner surface of the wrinkled capsule, I usually open the cornea, pass a pair of iridectomy forceps into the eye, and seizing the opaque membrane withdraw it at once. The pupil must be kept fully dilated with atropine, and the compress and bandage applied as usual after these operations.

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* "Notes on Operation for Cataract." By Surgeon-Major H. Cayley. *Indian Annals*, July, 1875.

Cataract complicated with synechia.

As I before remarked, we sometimes meet with instances of cataract complicated with synechia. Before attempting any operation in these cases, we must endeavour carefully to ascertain what amount of vision the patient possesses, by moving a bright light before his eyes; if he is unable, even in a dark room, to see the flame of a lamp, it is seldom that we can do good by means of an operation; for the chances are, that although we remove the opaque lens, the retina will have been so far involved as to prevent our patient's benefiting much by the extraction.

Treatment of.

In operating in instances of cataract complicated with synechia, we should first perform iridectomy, and then remove the lens with a scoop, or Bowman's traction instrument.

Capsular cataract after extraction.

Capsular Cataract.—One of the varieties of capsular cataract with which we have to deal, is that which occurs after the removal of an opaque lens. The patient may have made a good recovery from the operation, but still complains of dimness of vision; the cause of this will probably be detected on dilating the pupil, and examining the eye by the lateral method of illumination, when a slight film may be seen extending behind the pupil, occasioned by an opaque layer formed on the inner surface of the capsule, which had not been entirely removed at the time of the operation. The epithelial cells produce a kind of abortive lenticular matter, or it may be that neoplasms grow from them, rendering the inner surface of the remains of the capsule more or less opaque.

After inflammation.

Capsular cataract, again, may occur after irido-choroiditis, and inflammatory affections of the deeper structures of the eye. In these instances we shall at once understand the nature of the case, from the presence of complications such as exist after iritis: synechia, loss of brilliancy in the fibrous structure of the iris, immobility of the pupil, and so on. In these cases the epithelium lining the capsule appears to become involved in the hyperplasia, and neoplasms are formed, which becoming organized induce capsular cataract, and very probably subsequent degeneration and opacity of the lens substance. Capsular opacities of this kind are often star-shaped, the most central

From changes in the epithelium.

portion looking chalky, and shading off towards the circumference of the lens.

From external deposits.

Lastly, capsular cataracts may occur from the formation of neoplasms (the result of iritis) on the anterior surface of the lens (capsule). In this case the neoplastic formations are simply deposited on the capsule, and becoming organized, give rise to an opacity, which is generally complicated with extensive synechia, if not with closed pupil. Organized deposits may likewise form on the anterior surface of the capsule in instances of suppurative keratitis, the formation originating in the cornea, and being subsequently deposited on the lens. And lastly in instances of purulent conjunctivitis among infants, the cornea may ulcerate, the lens is forced forwards against the ulcer, neoplastic formations form on its capsule, then the ulcer heals, and the lens returning to its normal position retains the opaque formation it received when in contact with the cornea.

Treatment.

False cataract after extraction.

Considerable care is necessary in operating upon capsular cataracts which have formed after the removal of the lens; all irritation must have subsided in the eye before any attempt is made to break down the opaque capsule, and it is hardly likely, therefore, that we shall be able to operate under a period of two months from the date of the extraction.

Operation with one needle.

The most simple plan of destroying these opaque bands is to pass a needle through the cornea, the instrument having a cutting edge, so that we may be able to divide the opaque capsule with it. The patient having been placed under the influence of chloroform, and laid on his back, a stop-speculum is to be adjusted, and the eyeball fixed, an assistant seizing a fold of the lower part of the conjunctiva with a pair of forceps. The surgeon then passes the needle through the cornea, and behind the capsule, so that it may be made to cut an opening through, or break down the opaque membrane; there is no necessity for passing the needle deeply into the vitreous, our object is simply to "comminute it (the opaque membrane) without any drag on the contiguous parts, either of the capsule or iris."*

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* Bowman on Capsular Obstructions: *Ophthalmic Reports*, vol. iv. p. 364.

Use of two needles.

It often happens, however, that the opaque membrane or band yields to the needle, so that it is impossible to break it through; under these circumstances a second needle is to be introduced through the cornea, at a point nearly opposite the first one, and the extremity of one being passed behind, and that of the other in front of the opaque band, the needles are made to rotate round one another, so as to tear down the capsule.

Closed pupil.

In some cases the pupil is completely closed by the remains of the capsule, and neoplastic elements resulting from secondary iritis. The communication between the anterior and posterior chambers being thus cut off, glaucomatous changes are apt to occur in the eye, indicated by supra-orbital pain and increased tension of the globe. In cases of this kind, whether complicated with glaucoma or not, it is most advisable that a portion of the iris should be excised, and the opaque membrane which adheres to it removed. I think it is better at once to resort to an iridectomy in these cases; or to follow the practice advocated by De Wecker, which consists in making an opening sufficiently large in the cornea to allow of the introduction of the blades of his forceps scissors into the eye, one blade of this instrument is passed through and behind the iris and exudation mass, the other blade along the posterior surface of the cornea. With one or two incisions a portion of the iris is removed, but in some instances on making a single cut through the false membrane and iris, the edges of the wound retract to such an extent as to leave a very good opening for the passage of light into the eye.

Treated by iridectomy.

After-treatment.

The after-treatment in these cases of capsular cataract, consists in keeping the pupil as fully dilated as possible, and the eye at rest by means of a light pad and bandage; it is also advisable to confine the patient to a dark room, until all signs of irritation have passed away from the eye.

Traumatic Cataract.

Traumatic Cataract, whether arising from an accident, or following an operation involving the lens, will generally vary according to the size of the opening made in the capsule, and the age of the patient.

If only a small opening is made in the capsule of the lens, a portion of its cortical substance may pro-

A small wound may leave few traces.

lapse through the wound, undergo fatty degeneration, and become absorbed; the edges of the wound in the capsule then fall together and unite, and a small cicatrix alone remains to mark the site of the original injury.

If larger, some opacity.

If the opening is more extensive, the aqueous finds its way between the capsule and the cortical substance, and produces opacity of the latter. Unless the lens is injured the opacity may be superficial; neoplasms may form round the edges of the wound in the capsule, which may close, and the epithelial cells remaining intact, much of the original transparency of the lens may return.

In severe wounds,

Lastly, if the capsule be extensively lacerated, and the aqueous has free access to the lens; degenerative changes make rapid progress in the lenticular matter, which is soon rendered opaque throughout its whole extent. During these changes the lens becomes swollen, and by the pressure it exerts on the iris, may set up considerable irritation in the part, very probably leading to irido-choroiditis, and by sympathetic action too often involving the other eye. In other cases, the pressure of the swollen lens on the parts around induces much congestion of the choroid, and may lead to glaucomatous changes in the eye. The risk of complications of this kind is much increased, if any portion of the lens fall forwards into the anterior chamber; for by coming in contact with the anterior surface of the iris, it greatly increases the irritation going on in the eye.

Lens swollen and opaque.

Sets up inflammation.

Traumatic cataract from a blow.

It by no means always happens that traumatic cataracts are the result of incised wounds of the capsule; sometimes the capsule is ruptured from a blow on the eye, usually near some part of its circumference, and the aqueous, finding its way into the lens, causing a traumatic cataract.

Diagnosis easy.

A mistake can hardly be made in diagnosing traumatic cataract: the patient's sight has probably been perfect up to the time of receiving a blow or injury on the eye, and on examining it we find that the lens is opaque. It is impossible, however, to predict the nature and extent of the complications which may occur in the choroid or retina, especially in instances of traumatic cataract following blows.

Foreign bodies, in some few instances, have been known to pass into the substance of the lens, and without exciting any very great irritation, have induced partial fatty degeneration and softening of the lenticular matter, and then fallen forwards into the anterior chamber. In cases of this kind it may not be possible to see the foreign body in the first instance, on account of the opacity of the lens-substance around it. But instances of this description are very rare: far more commonly a foreign body in the lens gives rise to a traumatic cataract, and usually to intense inflammation of the iris and deeper structures of the eye, which, unless relieved, may terminate in abscess of the globe, and very probably in sympathetic irido-choroiditis in the sound eye.

Foreign bodies in the lens.

Treatment.—If but a small opening has been made through the capsule, it will only be necessary to dilate the pupil, and keep the eye at rest with a pad and bandage; the parts may recover themselves in the course of time, a minute cicatrix alone remaining to indicate the seat of the injury in the capsule.

Treatment.

Atropine and rest.

If the damage done to the eye has been more severe, for the first few days perhaps after the accident, the anterior chamber will be found full of blood; and when this has become absorbed, the lens will be found opaque; but as I have before remarked, we shall then be unable to ascertain the nature of any complications which may have occurred behind the opaque lens. In these cases atropine must be applied to the eye, and the parts kept perfectly at rest for a few days.

If inflammatory symptoms set in, or have occurred before we see the patient, it is well to administer chloroform, and having first performed an iridectomy, to extract the lens by the scoop operation at once. This proceeding will have to be adopted sooner or later, and in the meantime we run the risk of sympathetic irritation being established in the sound eye, if we allow the injured lens to remain *in situ*. I am aware that in time the irritation caused by a traumatic cataract may subside, especially if the pupil dilates under the influence of atropine; but even in spite of this I am convinced that in the long run, and in the majority of cases, it is better to remove the opaque lens as soon as possible; and doubtless an iridectomy is a most useful and necessary proceeding in this class of cases.

In case of inflammation remove the lens.

Delay hazardous.

It may happen after an injury to the eye, particularly among patients suffering from excessive myopia, dependent upon posterior staphyloma, that detachment of the choroid occurs, and that in consequence opacity of the lens gradually supervenes; but in cases of this description we shall have none of the urgent symptoms of irido-choroiditis present, which mark cases of traumatic cataract where laceration of the capsule has taken place; moreover, the opacity comes on comparatively slowly.

Late opacity from detached choroid.

Extraction.

The removal of the lens by linear extraction in cases of traumatic cataract requires no particular description, the cataract being extracted immediately after the iris has been excised. Provided the cornea has not been lacerated, nor a prolapse of the iris taken place, complicating the case, we may operate most advantageously through the upper section of the cornea, removing the superior one-fourth of the iris. But if a prolapse of the iris exists, and the injury is a recent one, the protrusion not having become fixed to the edges of the lacerated cornea, it is well to excise a portion of the iris, including the prolapse; by so doing, we not only secure the advantages of the iridectomy in the extraction of the lens, but also adopt the best means for curing the prolapse. For instance, suppose that a wound has been made through the outer part of the cornea, and the iris drawn into it, and that the capsule having been ruptured, a traumatic cataract exists with symptoms of intense irido-choroiditis, I should, if the case were a recent one (having put the patient under the influence of chloroform) open the sclerotic, and after removing the outer fourth of the iris, proceed at once to extract the lens. We must expect in a case of this kind to lose a considerable part of the vitreous; but this is of little consequence, as we may not only save the injured eye, but prevent the other one from being affected by sympathetic irritation.

If iris prolapse, excise it.

Palliative treatment useless.

Palliative measures, such as rest, leeches, atropine, soothing applications, and so on, are recommended by some surgeons in these cases, before resorting to the treatment above indicated; but I have seen so much harm result from waiting, and such admirable results ensue from the operative treatment, that I can safely recommend the latter plan, and invariably practise it myself.

In some cases the lens is not only rendered opaque from the effects of a blow on the eye, but also partly dislocated, irido-choroiditis also existing. Under these circumstances we must be very careful in operating: the lens will easily slip from the scoop, and fall back into the vitreous chamber. To prevent this accident, it is well first to dilate the pupil as fully as possible, then pass a needle through the cornea, and by means of a gentle drilling motion lacerate the capsule; some of the soft lenticular matter escapes, and the vitreous thrusts the lens forwards against the cornea, and we may then with safety proceed to the iridectomy and removal of the lens, the scoop passing behind it without difficulty.

Management of displaced lens.

Dislocation of the Lens.

Dislocation of the Lens.—Dislocation of the lens may be either complete or partial; in the former, the lens is forced out of the eye through a wound in the sclerotic or cornea, but in partial dislocation the crystalline remains attached to some portion of the suspensory ligament, and may fall forwards, backwards, or to either side of its normal position in the eye.

1. Complete dislocation.

1. *Complete dislocation* of the lens is most commonly caused by a sharp blow, such, for instance, as would be given by a raquet-ball, or some such small and hard body. The sclerotic is usually ruptured at its inner and upper part, immediately beyond the margin of the cornea, and the lens escaping through a rent in this situation may be lodged beneath the conjunctiva. An injury causing such a considerable lesion of the eye as this, is always complicated with more or less damage to the iris, which is usually torn from its attachment, to a greater or less extent. Immediately after the accident the anterior chamber is filled with blood, and extensive ecchymosis of the skin and conjunctiva occurs.

Rent seen in sclerotic.

Lens beneath conjunctiva.

On examining the eye, the black chasm through the sclerotic will be at once visible, and the lens may generally be recognised by its form and size beneath the conjunctiva. It soon loses its transparency, and then appears as an opaque mass in the situation above indicated. In other cases the form of the lens is lost by compression in its passage through the rent in the sclerotic, and until it becomes opaque, we may be unable to distinguish it from vitreous.

Lastly, the lens may be driven completely through the sclerotic and conjunctiva, and fall on to the patient's cheek.

Treatment. Remove the lens. Close the wound.

Treatment.—If the dislocated lens is still to be seen beneath the conjunctiva, it is well to slit open the mucous membrane and remove it. Under any circumstances the rent in the sclerotic should be closed, its edges being brought together with one or more fine silk sutures; the eyelids must then be shut, and kept at rest until the irritation excited by the accident has entirely subsided.

2. Partial dislocation.

2. *Partial Dislocation of the Lens.*—This accident usually occurs from a blow on the eye or forehead, the lens being partially torn from the suspensory ligament, and displaced either upwards, downwards, or to either side; in some cases it is thrown forwards, and rests partially or completely in the anterior chamber. Under these various circumstances, the patient's sight is more or less impaired, for the dislocated lens not only becomes somewhat hazy, but by bobbing about behind the pupil interferes considerably with the perfection of vision.

Lens variously displaced.

May not directly follow the injury.

It does not always happen that the displacement of the lens immediately follows the receipt of an injury; several days may have elapsed since the accident, when from an effort of coughing or sneezing, the already damaged suspensory ligament is ruptured, and the lens dislocated.

On examining the eye, provided the lens has not been thrust forward into the anterior chamber (the pupil having been dilated with atropine), we shall observe the lens swinging about with every movement of the eye, its structure being slightly opaque, and the black chasm of the vitreous appearing behind that part of its circumference which has been detached from the suspensory ligament. The iris, from the loss of support afforded it by the lens, is tremulous.

Lens seen moving.

Iris tremulous.

Dislocation forwards:

If the lens has been dislocated forwards, it may occupy the entire pupil, and remaining almost transparent there may be some little difficulty in detecting the nature of the injury. The "light, however, being reflected by its edges, presents a prismatic or glistening circle within the eye, the iris is pressed back, rendering the anterior chamber larger than natural, and the pupil dilated and motionless."

Appearances.

The following is a case in point:—

CASE. W. Matthews, of the E. I. Railway, when a child received a blow on the forehead, after which his eyes became affected. In the left eye there is no lens, and the eye has been in its present state from the time of the accident: the lens has probably been absorbed. The right eye was healthy to within the last month, when he managed to strike it against a doorpost, and immediately afterwards his sight became much impaired. On his coming to me, I found the right lens dislocated forwards and distending the pupil; it was perfectly transparent, and as the man saw very well with the eye, I did not consider it necessary to remove the lens.

I saw this patient again two months after the accident: the lens was still in the same position, and quite transparent; but as it was evidently exciting irritation in the iris and choroid, I punctured it with a needle, and it speedily became opaque, and was then removed from the eye by linear extraction.

CHAPTER XIV.

PARALYSIS OF THE MUSCLES OF THE EYE—STRABISMUS.

PRELIMINARY REMARKS.

PRELIMINARY CONSIDERATIONS.—It will be advisable, before entering on the subject of this chapter, to make a few preliminary remarks on the innervation and action of the muscles of the eye, and to explain the mechanism of diplopia or double vision, that we may the better appreciate the symptoms complained of by patients suffering from paralysis of one or more of the muscles of the eye.

Distribution of nerves.

Innervation and Action of the Muscles.—The third pair of nerves divides into two branches in the orbit, the upper one supplies the levator palpebræ and superior rectus, and the lower branch sends nerves to the rectus internus, rectus inferior, obliquus inferior, and the sphincter pupillæ.

The fourth nerve supplies the superior oblique.

The sixth nerve the external rectus.

Combined actions of muscles.

1st. The cornea is inverted and everted in the horizontal meridian plane, by the action of the internal and external recti respectively.

2nd. The cornea is directed upwards by the combined action of the superior rectus and the inferior oblique.

3rd. The eye is turned downwards by the combined action of the inferior rectus and superior oblique.

4th. In moving the eye diagonally upwards and inwards, the rectus superior acts in combination with the rectus internus, being further controlled by the action of the inferior oblique.

5th. In moving the eye upwards and outwards, the rectus superior acts in conjunction with the rectus externus, the inferior oblique limiting the action of the rectus superior.

6th. The eye is turned inwards and downwards by the action of the rectus inferior and rectus internus, the superior oblique also controlling the action of the rectus inferior.

7th. The movement downwards and outwards is accomplished by the rectus inferior associated with the rectus externus, the superior oblique controlling the action of the inferior rectus.

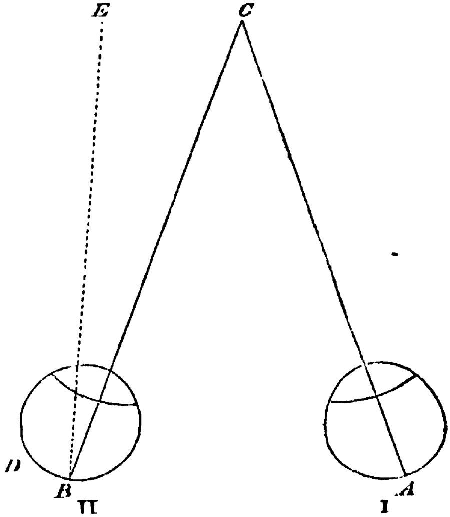
Diplopia.

Harmony of two eyes impaired.

Diplopia.—In order to insure correct vision the two eyes must work in unison; for if the rays of light do not fall upon exactly corresponding portions of the two retinæ, double vision or *diplopia* is the result. There are two forms of diplopia, the *direct* and the *crossed*; the former may be best understood by referring to Fig. 46. The left eye, B, in this case is supposed to be inverted, the right eye, A, is normal, and directed towards the object C, the rays from which fall on the macula lutea at A; but in consequence of the left eye being inverted, the rays from C will fall on the point B, internal to the macula lutea D, and the image formed will be mentally projected, in a line perpendicular to this spot, in the direction of E; and thus two images of the figure C will be visible, one in its real position, and the other to the left of C at E. The reverse of this would, of course, hold good, if the right eye were inverted; the second image would then be to the right instead of the left of C.

Direct diplopia.

FIG. 46.

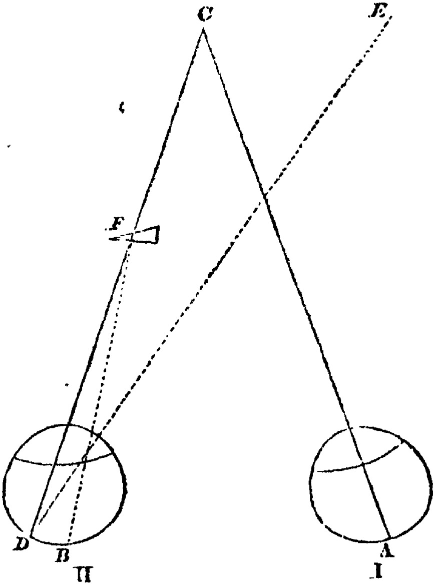


Crossed diplopia.

In the second form of diplopia, as its name implies, the images cross one another, as shown in Fig. 47.

The left eye, B, is supposed to be everted, and the right eye A, is in its normal position, the rays of light from the luminous point C falling upon the macula lutea at A'; but as B is everted, the rays from C do not impinge upon its macula lutea at B, but on a point external to it at D, and are projected in a line perpendicular to this point in the direction of E, so that they cross those proceeding from C to A, and hence the crossed diplopia.

FIG. 47.



Prisms to correct diplopia.

I may here remark, that the course of the rays C D may be changed by means of a prism, as at F, by which they are bent towards the base of the prism, and so fall on the macula lutea at B; in this way the diplopia will be corrected; for although the eye B is everted, the rays from C are directed upon its macula lutea by means of the prism F, and binocular vision is thus restored.

To test binocular vision.

Prisms of this kind are now in constant use, not only for rectifying slight diplopia, but also as a test of the presence of binocular vision in cases of *strabismus*. It is most important that we should be accurately informed on this point; for, unless binocular vision exists, we cannot operate for the cure of strabismus with any hope of success. It does not follow, that because a patient squints, he must suffer from diplopia; in fact, in the majority of cases of long-standing strabismus, the functions of the whole or a portion of the retina in the affected eye are destroyed or suppressed, and it is then useless to interfere, unless for appearance sake.

Principle and method of using them.

The existence of binocular vision is ascertained in this way. If a prism be held with its base inwards, before either eye, rays passing through it will be defracted towards its base, and falling on the retina, will form an image internal to the macula lutea, which being projected, as in Fig. 46, in the direction E, direct diplopia will be the result. But the other eye will immediately and unconsciously endeavour to correct this, and by an involuntary motion, it will turn inwards (become inverted), so that the rays of light from the object under observation may fall upon a corresponding portion of its retina, internal to the macula lutea, and thus correct the diplopia. Consequently, if under any circumstances the prism has this effect, we may be sure that binocular vision exists, and the reverse, if no such changes are induced.

The prism test is very useful in cases of assumed blindness, for as Professor Longmore remarks, if a prism of 12° or so, be held with its base upwards or downwards before the eye in which visual power is acknowledged to be retained, and the person who is subjected to the test on being asked what effect it has on his sight, states that it causes double vision, the simulation is proved, for diplopia could only result by both eyes seeing. If the base of the prism is turned inwards, and the other eye squints, evidently an effort is being made to prevent double vision, and the assertion of blindness in the squinting eye is therefore absurd.

Primary and secondary angles of squinting.

Primary and Secondary Angles of Squinting.—In the diagnosis of cases of paralysis of the muscles of the eye, as distinguished from strabismus, it is very necessary to notice if the secondary angle of squinting is greater than the primary angle; the former invariably forms the greater angle in all cases of paralysis. By the primary angle of squinting, we mean the angle of deviation of the optic axis of the diseased eye, from an object upon which the other eye is fixed. Upon covering the sound eye, the other makes a movement in order to fix its optic axis on the object, causing the covered eye to move in association with it; this deviation of the sound eye is called the secondary angle of squinting, and will be found greater than the primary angle through which the weakened eye has moved.

Illustration.

For instance, suppose the external rectus of the left eye is paralysed, the patient is therefore unable to evert this eye; but if a candle be held in front of his face, and the right eye closed, on moving the candle to the left of the patient, the left eye makes an effort to follow it, and may be moved perhaps one line outwards; the right eye, we shall find, has made an associated movement inwards of two lines. In this case, therefore, the secondary angle is evidently greater than the primary one.

Why the secondary exceeds the primary angle in paralysis.

Von Graefe explains this phenomenon as follows. The nervous apparatus of the left external rectus being defective, it requires an increased effort of the will to evert the left eye; but this increase of force cannot be confined to one eye, it is equally propagated to the sound one; and as the healthy muscle responds normally to the increased nerve force, the right eye is inverted considerably more than the left one is everted. As a consequence of the want of action in the external rectus, after a time, secondary changes occur in the antagonistic muscle, leading to alterations in its contractile power, and the diplopia becomes complicated with strabismus, as I shall more fully explain by-and-by.

PARALYSIS.

PARALYSIS OF EXTERNAL RECTUS.

How detected.

PARALYSIS OF THE EXTERNAL RECTUS.—Let us suppose the left external rectus is affected. On holding a lighted candle, or some such object, at a distance of five feet from the patient's face, we find both eyes are fixed on it, and it is only when the candle is moved to the left of the patient that the want of action in the muscle becomes apparent; the optic axes then no longer work in unison, and diplopia is the result. This is particularly noticeable if the candle is held a little below as well as to the left side. On closing the right eye the secondary angle of squinting will be found greater than the primary angle.

Nature of the diplopia.

The diplopia which exists in a case of this kind will be readily understood by reference to Fig. 46, for as the object is moved to the left of the patient, the rays of light must fall upon a part of the retina internal to the macula lutea, and being projected forwards the diplopia will be direct. In order to overcome this diplopia the patient is apt habitually to turn his head to the left, and also in striking at an object is likely to hit too far to the left, especially if the right eye is closed and the blow is a rapid one. In the form of paralysis we are now considering, the action of the muscles of the eye, with the exception of the rectus externus, may be perfect.

PARALYSIS OF THIRD NERVE.

PARALYSIS OF THE THIRD NERVE may be complete or partial; in the former case, all the muscles supplied by this nerve are paralysed, and in the latter, one or more only may be affected.

Ptosis.

Eye can only move outwards.

Diplopia and vertigo.

Supposing complete paralysis of the third nerve of the left eye exists, the first symptom we shall notice will be loss of power of the levator palpebræ, the patient being unable to raise his upper eyelid. On opening the lids, we shall find that our patient can only direct the eye outwards; in other directions it is unable to follow an object placed before it, so that if the latter be held above, below, or to the right of the affected eye, diplopia is produced. In consequence of the illusion thus created in the mind, when the patient attempts to walk across a room to reach an object in front of him, he is apt to stagger much as a drunken man would do.

Exopthalmos.

Slow pupil.

In some cases exophthalmos results from the loss of power in the recti muscles, and their inability to resist the natural tendency of the elastic contents of the orbit to thrust the eye forwards. The pupil acts very slowly under the stimulus of light, and is more or less dilated.

In instances of complete paralysis of the muscles supplied by the third pair, we have only to bear in mind their combined action, in order that we may understand the nature of the diplopia that must occur.

PARALYSIS OF INTERNAL RECTUS.

Divergent squint.

PARALYSIS OF THE INTERNAL RECTUS.—The eye cannot be moved inwards, and a crossed diplopia results if an object is held to the right of the patient (supposing the left eye affected), the squint being divergent. The diplopia is most apparent if the object is held to the right, and above the level of the patient's eye. The secondary angle of squinting is greater than the primary angle, and the patient habitually turns his head towards the right, in order that he may overcome the diplopia as far as possible.

Characters of the diplopia.

The double images are parallel and equally high; except in the diagonal positions to the right and upwards, and to the right and downwards, where there is an obliquity and a difference in height—the image of the left eye, on looking towards the right and upwards, being inclined to the right and lower—whilst on looking towards the right and downwards, it is inclined obliquely to the left and higher.*

PARALYSIS OF RECTUS SUPERIOR.

PARALYSIS OF THE RECTUS SUPERIOR (left eye).—The movements of the eye before the horizontal meridian plane are normal; but if an object is moved from below upwards above this level, the patient's left eye cannot follow it. The cornea is seen to be directed forwards and slightly outwards, on account of the action of the inferior oblique muscle being unopposed.

Eye cannot be raised.

Is slightly everted.

If the right eye is covered, and an object is held above the patient's eyes, the paralysed eye being directed upwards as far as the paralysis will allow, the right cornea is turned upwards and outwards to a greater extent than the left one. The chances are, if the patient strikes quickly at an object, that he will hit too high. In order to correct the diplopia as far as possible, he carries his head directed backwards and upwards.

Diplopia on looking up.

If the object be held above the horizontal meridian plane of the eye there will be diplopia, and one image appear above the other. The rays of light under these circumstances fall upon the inferior part of the retina of the affected eye below the macula lutea, and the image is therefore projected above that of the other eye; but in consequence of the slight eversion of the cornea which takes place in paralysis of the superior rectus, the images do not appear precisely one above the other, the false image being to the right of the true one as well as above it; in fact, the diplopia is crossed, in consequence of the divergence of the optic axes.

False image above and to the right.

OF RECTUS INFERIOR.

PARALYSIS OF THE RECTUS INFERIOR.—The symptoms characteristic of this affection are precisely the reverse of those above enumerated in the instance of paralysis of the superior rectus.

OF THE INFERIOR OBLIQUE.

PARALYSIS OF THE INFERIOR OBLIQUE very rarely if ever occurs without some of the other muscles of the eye being involved.

PARALYSIS OF THE SUPERIOR OBLIQUE (left eye).—The

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* "Principles and Practice of Ophthalmic Medicine and Surgery," by T. W. Jones, F.R.S.; 3rd edit., p. 582.

Of the Superior Oblique.

patient complains that objects below the horizontal meridian of the eye appear as if double and unsteady; this fault is corrected to some extent by the head being thrown forwards and to the right.

Diplopia on looking down.

False image below and to the left;

appears nearer.

On examining the affected eye we find that objects are correctly seen above the horizontal plane, but that below it, in consequence of the cornea being directed upwards and inwards, while the right eye is directed downwards, the false image will be below and to the outer side of the real one, the deviation of the two figures being greater as the object is placed further beneath the horizontal plane. The secondary angle of squinting is greater than the primary angle. It is a remarkable fact, that in this form of paralysis the false image appears to be nearer to the patient than it really is.

I have already considered the circumstances of paralysis of the sphincter pupillæ under the head of mydriasis, and may therefore proceed to make a few remarks on the causes, prognosis, and treatment of the various paralytic affections of the muscles of the eye.

Causes.

The Causes of Paralysis of the Muscles of the Eye may be divided into two classes—1st, those affecting the nerve; and 2nd, disease involving the nervous centre.

1. In the nerves. Syphilis.

1. Among the first of these causes syphilis holds a prominent place. I need hardly remark that the nerve may be affected with neuroma of a syphilitic origin in any part of its course; but fatty degeneration of the nerve as a result of syphilis, is probably a more frequent though less palpable source of paralysis of the muscles of the eye. Lastly, syphilitic nodes or a thickening of the sheath of the nerve may, by pressing on its true nervous elements, induce paralysis.*

Rheumatism.

Rheumatism, again, appears to be a common source of paralytic affection of the muscles of the eyeball. The attack usually comes on after exposure to cold, and is generally accompanied with violent pain in the head and supra-orbital region.

Malaria.

Malarious influences have evidently a direct relation to the class of diseases we are now considering; hemicrania, apparently depending upon miasmatic influences, being occasionally followed by paralysis of the orbital branch of the third nerve of the corresponding side of the head.

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* Cases of Paralysis of the Oculomotorius, by Professor von Graefe: *Ophthalmic Review*, vol. i. p. 216.

Mechanical compression.

Effusions of blood into the orbit, or tumours in this locality may, by pressure upon the nerve, impair its functions, and cause paralysis of the muscles of the eye. Abscess in the cellular tissue, or disease of the bones of the orbit may act in the same way. Lastly, Mackenzie has drawn attention to the fact, that the third nerve may be injuriously compressed by the posterior artery of the cerebrum, and the superior artery of the cerebellum, should these vessels happen to be much congested, the nerve passing between them as it emerges from the brain.

2. Disease of the brain.

2. Of the second class of causes which produce paralysis of the muscles of the eye—viz., those originating in the nervous centre, we may reasonably expect to meet with symptoms indicating the seat of the lesion, and in all probability the patient's intellectual faculties will be impaired, or paralysis of other parts of the body will exist; but, as I before remarked when speaking of ptosis, the consideration of these forms of disease would involve us in that most difficult and obscure study—the pathology of the brain, which certainly does not fall within my province.

Diagnosis.

Diplopia obstinate.

I may however observe that the diplopia accompanying paralysis of the third pair, and depending on lesions of the brain, has a marked peculiarity, in that "the double images in these cases show a very great disinclination to be united. Even with the most carefully selected prism it is found difficult, or even impossible, to unite them; and even if we have effected this, the diplopia generally awakens again, as soon as a very slight alteration is made in the strength of the prism, or in the position of the object. If we find that several muscles, which are supplied by different nerves, are paralysed, together with one or more muscles supplied by the oculomotorius, particularly if both eyes are affected (and we can find no cause within the orbit), we may suspect some cerebral lesion. The same may be said with regard to a succession of paralyses in different muscles. If several of the muscles, furnished with nerves of the third pair, are *successively* affected, and then perhaps the trochlearis or abducens also, and after this, one or more muscles of the other eye, we are justified in thinking of a cerebral cause."[*]

Prognosis uncertain in brain cases.

The Prognosis in cases of paralysis dependent upon causes situated at the base of the brain, or within the brain itself, must be more or less dubious, but will evidently depend very much upon the nature of the cerebral lesion; we may hope for amendment in the diplopia if the cerebral symptoms disappear, but hardly otherwise.

Favourable in syphilis or rheumatism.

In cases of paralysis of the nerve depending on syphilitic or rheumatic influences, we may fairly hope that with proper treatment the paralysis will gradually disappear. The same remark applies to instances of paralysis depending on malarious influences.

Must vary with cause of pressure.

The prognosis to be given in cases of affections of the muscles of the eye, caused by pressure upon the nerve from effusion of blood, or from morbid growths within the orbit, will evidently very much depend upon the possibility of the removal of the compressing force. If there is no likelihood of this, it is hardly possible that the affection of the muscles of the eye will be overcome. On the other hand, effused blood, or even an abscess, may be got rid of, and if so, we may fairly hope for a favourable result as regards the muscular apparatus of the eye.

Treatment.

Treatment.—In instances of paralytic affections of the muscles of the eye depending upon syphilitic or rheumatic influences, we shall have to enforce a plan of treatment such as I have before recommended in cases of the kind. The tendency of these paralytic affections is to recovery, especially if nature is judiciously assisted in her efforts to cure.

Tendency to recovery.

Open an abscess.

In the case of paralysis depending on causes situated within the orbit, should this be an effusion of blood, it is well to allow it to become absorbed; abscesses should be opened as soon as possible, but I would refer to Chapter III., on diseases of the orbit, for an account of the treatment to be followed in these affections.

I before remarked that *prisms* are employed in

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[*] Mr. Wells on Paralysis of the Muscles of the Eye: *Ophthalmic Hospital Reports*, p. 29, July, 1860.

Exercising weak muscle by prisms.

some cases of diplopia with advantage. Supposing the diplopia has to some extent been overcome either by the efforts of nature or medical treatment, and if no contraction of the opposing muscle has taken place, we may hope by the use of prisms to strengthen the paralysed muscle, giving it gentle exercise in the following way for some three or four hours every day.

Mode of using them.

I have already explained the action of the prism (Fig. 47): light being defracted by it towards its base, we may in this way bend the rays of light into such a position, that they will fall upon the retina near the macula lutea of the diseased eye. In consequence of the great confusion of vision which is thus caused (the rays of light falling on the yellow spot in the sound eye, and very near it in the weak one), the paralysed muscle contracts, in order that it may correct the diplopia, by turning the axis of the diseased eye so that the two images may coincide; and by the daily exercise of this contraction, it gradually gains strength, and in time may work without the prism.* Glasses of this kind are especially useful during the progress of recovery from palsy of the sixth, or partial paralysis of the third nerve, in which the internal rectus is the only muscle, or the one principally affected.

Illustration.

Supposing the external rectus to be paralysed, the base of the prism should be directed towards the temple, so as to defract the rays of light on a spot internal to the macula lutea; the external rectus, to correct the diplopia thus caused, would contract and slightly evert the eye, and being gently exercised in this way, day by day, would gain strength, and perhaps ultimately recover its former power. In cases of paralysis of the other muscles of the eye, the base of the prism should be placed in such a position as to call the affected muscle into play, upon precisely the same principle as above explained.

Electricity.

Faradization is often most useful in cases of paralysis of the muscles of the eye, one pole being applied over the closed lid, and the other behind the corresponding ear. The remarks I have already made upon this method of treatment, when discussing the subject of paralysis of the orbicularis and levator palpebræ, are applicable to instances of paralysis of the muscles of the eye.

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* E. Meyer on Treatment of Strabismus by Prisms: *Brit. and For. Med.-Chir. Rev.*, vol. xxxiv. p. 392.

Operation of Tenotomy.—We have another means at our command for overcoming the diplopia produced by paralysis of the muscles of the eye, particularly if the antagonistic muscle is not affected by secondary changes; it consists in the operation of tenotomy, modified according to the circumstances of the case.

Tenotomy.

Let us again suppose that the external rectus of the left eye is paralysed, and that other means have failed to cure the disease; we may then divide the internal rectus, and fix its attachment to the sclerotic further backwards than its normal position. By this means we weaken the action of the internal rectus, so that in all probability the external rectus may be able to neutralize it, and thus overcome the diplopia.

Opposing muscle displaced backwards.

This operation, however, would only answer if the power of the external rectus were but slightly diminished; if much enfeebled, Von Graefe proposed that in addition to tenotomy of the internal rectus, we should divide the external rectus, and fix its attachment to the sclerotic close to the cornea. In this way, by increasing its power over the eyeball, and at the same time diminishing that of the internal rectus, we should correct the diplopia.

Weak one brought forward.

One of the drawbacks to this operation is, that the paralysed muscle, after long disuse, often undergoes fatty degeneration, and it is then of little use endeavouring to force it to increased action by an operation such as I have above indicated. But if the muscle has undergone fatty degeneration it is most probable that the internal rectus will have inverted the eye, so that we shall have a case of diplopia plus strabismus to deal with; we may nevertheless, if electricity combined with the prolonged employment of the iodide of potassium, has failed to restore power to the external rectus, endeavour to overcome this condition by an operation; the result, however, of any such proceeding is very doubtful, because, however much we may shorten the paralysed muscle, we cannot restore its functions by this means.

Should we think it advisable to operate, the internal rectus must be divided as described in cases of strabismus, but the subconjunctival cellular tissue should be disturbed as little as possible, so that the divided end of the muscle may not retract very far back, and then form its new attachment to the sclerotic; in fact we do not require to weaken the power of the internal rectus too much. Having completed the tenotomy of the internal rectus, we may proceed to shorten the paralysed muscle; the opening in the conjunctiva will have to be rather more extensive than in an ordinary case of strabismus; it is better in fact to expose the tendon of the external rectus, and insert a strabismus hook beneath it; a curved needle with a silk thread is passed through the tendon close to its insertion into the sclerotic, the suture is then to be tied. The muscle is subsequently to be cut through about three-fourths of a line from the suture, towards the angle of the eye, and another suture is to be passed through the retracted end of the muscle: the two sutures are to be tied together, and in this way the muscle is shortened. In fact all we have to do is to cut a small piece out of the tendon of the rectus and bring the divided ends of the muscle into apposition, so that they will unite, and thus shorten the muscle to the extent of the piece we have cut out of it. When writing the last edition of this work I had operated on several cases of this kind, and was disposed to think well of the proceeding, but subsequent experience has convinced me, that in my hands, the above described proceeding should seldom if ever be resorted to with the view of improving the sight in cases of external strabismus depending on paralysis of the internal muscle, but it may be useful to overcome the unsightly appearance of an eye affected with an external squint.

STRABISMUS.

STRABISMUS.

DEFINITION.—Formerly all cases in which there was a want of correspondence between the optic axes of the two eyes were classed as Strabismus, however different the character and cause of the disorder; now, however, that we have learnt to discriminate the various paralytic affections of the eye, we may restrict the term strabismus to those cases in which there is inability to bring both visual lines to bear simultaneously upon the same point, depending on some change in the muscles themselves and not in their nervous supply.

There is, therefore, a marked difference between cases

Difference between it and paralysis.

of strabismus and of paralysis. In the latter the movement of one or more of the muscles is impaired from a faulty state of its innervation, but in strabismus the muscles are in working order, so that the eye can move in all directions, the degree of tension of the affected muscle being alone at fault; the muscle is practically shortened, and the axis of the squinting eye is never in its proper place.

Paralysis complicated with strabismus.

But, as I have before remarked, after long-continued paralysis of one of the muscles of the eye, the opposing muscle, though healthy, may in the course of time contract, so that in instances of this description we have diplopia complicated with strabismus. On the other hand, in a confirmed squint, the opposing muscle from want of use becomes atrophied, so that ultimately the strabismus again becomes complicated with paralysis in the opposing muscle.

A strabismus may be either convergent, divergent, sursumvergent, or deorsumvergent, but the two latter are very rare forms of strabismus; an internal squint is the most common.

CONVERGENT STRABISMUS.

STRABISMUS CONVERGENS.—We may suppose that one eye only is affected. If an object be held before the patient's face, and he is directed to look at it, the working eye is fixed on the object, but the squinting one is instantly inverted. If the working eye is closed, the squinting one turns slowly outwards, and is fixed on the object, but if the other eye is opened the squinting one again rolls inwards.

Primary and secondary angles equal.

I have before explained the meaning of the term secondary angle of squinting, and laid it down as a rule that the secondary angle is always greater than the primary one in instances of paralysis; but that is not the case in strabismus, for if the working eye is closed, it will be inverted to exactly the same extent as the squinting eye is everted, when directed towards an object held before the patient's face.

Diplopia direct.

In consequence of the inability of the two eyes to fix their optic axes on the same object, double vision exists; and in cases of internal strabismus the diplopia is direct, the image observed with the squinting eye being projected towards the corresponding temple (Fig. 46).

Sight of affected eye may be suppressed.

The double vision may after a time disappear, the sight in the squinting eye becoming suppressed; this is particularly the case if the strabismus is very marked;

the rays of light from an object fall on the outer and less sensitive portions of the retina, and the impression is therefore ignored by the patient. Whereas, if the squint be only slight, the image falls upon the retina near the macula lutea, and this part of the retina being very sensitive the confusion of vision becomes very great indeed.

In the above remarks we have supposed only one eye to be affected, but this is by no means always the case.

Alternating strabismus.

The squint may be alternating, and appear first in one eye and then in the other, so that if the apparently working eye is closed, the squinting eye assumes its normal position; but in place of becoming again inverted when the former is opened, it retains its natural position, and the other eye remains inverted. In fact, first one and then the other squints; it appears to be a matter of indifference to the patient which eye he uses, but he is unable to concentrate both his optic axes simultaneously on the same object. In these cases the sight of both eyes is usually equally good.

Causes of strabismus.

Causes.—The remote causes usually assigned for strabismus are very numerous: among these I may mention, convulsions, worms, exanthematous diseases, injuries to the head, and the habit of imitating a person affected with strabismus. The more direct and immediate causes of strabismus we may group as follows:—I. Impaired vision of one or both eyes. II. Primary affections of the muscles of the eye. III. Anomalies of refraction of the eye.

Impaired vision.

I. Impaired vision of one or both eyes. If the sight of one eye is impaired from an opacity of the cornea, or of the deeper structures of the eye, the patient is likely to be troubled by the presence of the faulty image, and the eye involuntarily squints, in order that the image may fall upon the peripheral and less sensitive part of the retina; in time the diseased eye may cease to recognise the impaired image, but the strabismus remains.

Paralysis.

II. Primary affections of the muscles, paralysis. In speaking of diplopia arising from paralysis of the muscles, I mentioned that the opposing muscle to the paralysed one might, in the course of time, become contracted, inducing strabismus.

Wounds.

In this way also wounds, or injuries of one of the muscles of the eye, may, by impairing its contractile power, prevent its effectually resisting the opposing muscle, and a strabismus occurs in consequence. We occasionally notice this form of squint following an operation for the cure of strabismus; the tenotomy having been carelessly performed, the opposing muscle is unresisted, and contracting, draws the eye outwards or inwards as the case may be.

Hypermetropia.

III. Anomalies of refraction of the eye. Of these hypermetropia is by far the most common cause of internal strabismus, the defective accommodation of the eye being partially overcome by an increased convergence of the optic axes (*see* Chapter XV.). At first the squint is periodic, the effort by which the internal rectus is called upon to act being only occasional, when near or minute objects are under observation; but if the defective accommodation is not overcome by the habitual use of convex glasses, the strabismus is almost certain to grow permanent.

Myopia.

Myopia may, though rarely, induce an internal strabismus, from the fact of the internal rectus being overworked, in the constant straining efforts at convergence which the patient makes in looking at objects placed close to his eye, in order that they may be clearly seen.

DIVERGENT STRABISMUS.

STRABISMUS DIVERGENS.—An external squint is a rare affection as compared with the number of cases of internal strabismus we meet with. In external strabismus the diplopia is crossed: the image, falling on a part of the retina external to the macula lutea, is projected inwards (Fig. 47). The phenomena of external strabismus, in fact, are precisely the reverse of those of an internal squint, the affected eye being everted, and moving from without inwards when an object is held in front of it, and the sound eye is closed. The secondary angle of squinting is equal to the primary angle.

Diplopia crossed.

Eye everted.

Causes.

Causes.—Some of the circumstances already mentioned as giving rise to convergent squint may also produce divergence. The most common cause of external strabismus is myopia. I have above remarked that this affection of the accommodation of the eye may induce an internal squint, from contraction of the internal recti due to overwork; this, however, is a very rare sequence of myopia; far more commonly an external strabismus is induced by the insufficiency of the internal recti with which it is associated.

Myopia.

Weakness of internal rectus.

Myopia in very many cases depends on posterior staphyloma, the eyeball being elongated from before backward. Under these circumstances it requires a greater effort on the part of the internal recti to maintain the necessary convergence of the optic axes for distinct vision, and consequently the muscles become fatigued: the maculæ luteæ of both eyes are no longer kept steadily fixed on the object under observation, diplopia results, and to remedy the confusion one eye flies outwards, so that the rays may fall upon the least sensitive parts of the retina (its periphery) and the images be widely separated; and thus in the course of time an external strabismus occurs. I have already explained, when discussing the subject of posterior staphyloma, Dr. Giraud-Teulon's theory regarding the connexion of this affection with insufficiency of the internal rectus; he considers that the muscular defect is the cause of the myopia and posterior staphyloma, leading also to external strabismus, rather than that the myopia induces the divergent squint.

Wounds.

Wounds of the internal rectus may cause an external strabismus.

Rare forms of squint.

Strabismus *sursumvergens* and *deorsumvergens* are rare forms of disease, and seldom occur unless in connexion with paralysis.

Prognosis.

Good if vision binocular,

and operation early.

Prognosis.—Before recommending any particular line of treatment in cases of strabismus, we must ascertain if the patient possesses binocular vision, p. 535: if this is not the case, our prognosis should be guarded as to the probability of a cure being effected. In ninety per cent. of the cases of strabismus operated on by Von Graefe, binocular vision was absent: but of these some fifty per cent. recovered it to a greater or less extent, after an operation. Not only, however, is binocular vision often wanting in these cases of strabismus, but in time the patient's vision in the squinting eye becomes completely destroyed. It is consequently always advisable to operate in cases of strabismus as soon as practicable, so as to anticipate these changes in the visual powers of the squinting eye.

In old cases must vary with state of vision,

Subsequently, the strabismus having existed for some time, our prognosis, as to the effects of an operation upon the visual powers of the affected eye will depend upon the degree of impairment of vision. If the sight is pretty good, and the squinting eye can be steadily fixed on an object in front of it, while the working eye is closed, we may expect much benefit from an operation. But if the sight is already much injured, and the patient cannot fix the squinting eye on an object, although the other eye is closed, we can hope to gain but very slight advantage from an operation.

and power of fixing the eye.

Treatment.

Treatment of Strabismus.—The methods which have from time to time been advocated for the cure of strabismus have been very numerous, but for all practical purposes we may confine our attention to tenotomy of the affected muscle, our object being to weaken the power of the muscle, and thus overcome the strabismus.

Glasses.

Tenotomy.

No doubt much may be done, and must be done, by means of convex glasses in the case of hypermetropia, and of concave ones in myopia, to overcome the abnormalities in the refractive media which induce a squint; but strabismus having been once acquired, division of the muscle which causes the squint is the treatment upon which we must rely.

Children are frequently brought to us, in which hypermetropia and a fixed internal strabismus exist; parents naturally object to an operation, and tell us of instances in which so-and-so's child squinted and recovered without an operation: our course in such cases is clear, we can only advise the proper and rational mode of overcoming the defect, which is by an operation, and the earlier it is undertaken the better for the patient, provided the squint is a fixed one. If an alternating squint, the operation may be postponed.

Often necessary in both eyes.

It is almost always necessary to divide the muscle not only of the squinting, but of the working eye also, even in cases of monolateral strabismus, because the parallelism of the eyes is affected through means of a common motor influence; but if the internal rectus of only one eye is divided, its tendon retracts and forms an attachment to the sclerotic further back than that of its normal position: the muscle in the eye which has not been operated on is therefore anterior to the insertion of the internal rectus of the other eye, and the former muscle is longer (stronger), and has an advantage over the divided muscle when the eyes are made to converge on a near point. We should consequently divide the internal rectus in both eyes, and by putting back the attachment of both muscles equally, obtain parallelism of the eyes at rest, and also when converging.

Muscles to be divided at their insertions.

The relations of the tendons of the recti muscles to the capsule of Tenon have already been considered (Chap. I.), and it is only necessary for me to add that in dividing the tendons of the muscles for the cure of strabismus, we must cut through them at their insertion into the sclerotic, so as not to divide their connexions with the capsule of Tenon more than we can help. Further, it is far easier to increase the effect of an operation by subsequently dividing more of the tendon, than it is to overcome the defect produced by a too free tenotomy in the first instance.

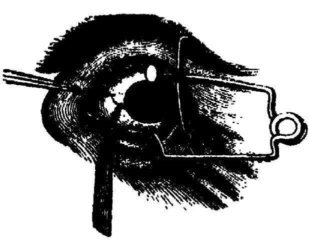
Operation.

The patient having been placed under the influence of chloroform, and the lids separated with a stop speculum (the internal rectus being the muscle to be divided), an assistant seizes a fold of the conjunctiva with a pair of forceps and everts the eyeball.

Division of conjunctiva.

The surgeon then nips up a fold of the conjunctiva with a pair of fine forceps at a line corresponding with the lower border of the muscle to be divided. The scissors should then cut through the fold of conjunctiva below the forceps (Fig. 48), dividing all the structures right down to the sclerotic. It is very important to expose the sclerotic clearly.

FIG. 48.

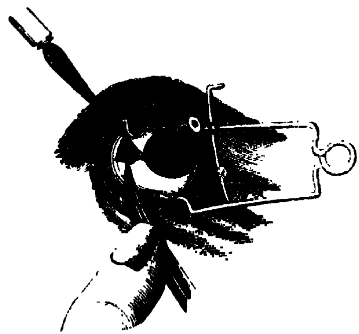


Passing the hook.

The surgeon then takes a Cowell's strabismus hook, and placing its point on the sclerotic, runs it a little downwards, so as to get below the muscle, and then well backwards, so as to get behind it; the point of the instrument being still kept on the sclerotic, is then moved upwards and forwards, so that the extremity of the hook protrudes under the conjunctiva above the upper border of the muscle. The internal rectus is now to be put on the stretch, by drawing the hook towards the outer angle of the eye, and while it is kept tense in this way the points of the scissors are to be introduced into the wound (Fig. 49), the lower blade passing beneath the tendon of the muscle in contact with the sclerotic, and the upper blade between the tendon and the conjunctiva. In this way the tendon of the muscle is to be cut through. The strabismus hook is then to be passed upwards and downwards against the sclerotic, so as to determine if any of the lateral offsets of the muscle have been left undivided; if so, they must be carefully cut through.

The after-treatment consists in keeping the eye at rest for a few days; a cold compress may be employed for the first twenty-four hours after the operation.

FIG. 49.



Test the power of divided muscle.

As soon as the patient has recovered from the effects of the chloroform, we must examine the eye operated on, in order that we may ascertain the condition of the internal rectus. It is evident that, if the operation has been successfully performed, the patient will still have some power of inverting the eyes through the attachments of the muscles to the capsule of Tenon, so that both eyes will converge upon an object held some six inches in front of the patient's nose; but when more closely approximated to the face, should not have sufficient power to turn the eyes any further inwards.

Action of muscle partly restored.

In the course of three or four days the divided ends of the muscles reunite with the sclerotic, at a point slightly further back than their original place of insertion, and then the action of the internal recti becomes more powerful, the eyes act in unison, and the squint in fact is cured.

Should it be necessary to divide either of the other recti muscles the operation may be performed after the method above described.

We not unfrequently meet with cases of strabismus in grown-up people, in which the sight of one eye is very defective, from want of use. In cases of this kind the squinting eye should be exercised in reading with a strong magnifier for three or four hours, the working eye being closed. Subsequently we may divide the muscle of the squinting eye with considerable advantage, but harmony of movement can rarely be obtained, from want of sensational guidance; and we should consequently in such instances only operate on one eye. Of course in younger people the sight of one eye may be very defective, and under these circumstances the above rule still holds good; only operate on the squinting eye.

In cases of convergent strabismus depending on paralysis or weakness of the external rectus muscle, we must treat the case upon the principles I have already described (page 543) of dividing the internal rectus, and at the same time shortening the external muscle, always bearing in mind the fact that we must subsequently endeavour to give tone to the weakened (external) muscle by means of a well and long continued course of local faradization.

Divergent strabismus, as I have before explained, is commonly due to insufficiency of the internal rectus and myopia; it may be produced from a defective operation for the cure of a convergent squint. In cases where the vision of one eye is very defective the eye often diverges: under these circumstances, for the sake of appearances, we may be called on to correct the squint, and shorten the internal rectus by means of the operation already described (p. 543), and at the same time the external rectus should be divided subconjunctivally, so that its insertion may be placed backwards. In fact for the relief of all cases of divergent strabismus, our object must be to shorten the internal rectus or bring its point of insertion into the sclerotic forwards, while we lengthen (so as to lessen the power) of the external muscle by dividing it and allowing the retracted extremity to unite to the sclerotic behind the point of its normal insertion.

Downward squint.

Downward squint.—This affection of the eye is of rare occurrence, but the following case given by Surgeon Partridge, of Bombay, is a remarkably good illustration not only of the symptoms, but also of the successful treatment of a case of the

Case.

kind:—Captain E., aged about 45, came under my care in September, 1869, complaining of defective vision and strabismus. On examination, I found that he only, as a rule, used the right eye, and had acquired a habit of half-closing the lids of the left eye, to avoid confusion of images. If the right eye was covered, he could see, though not clearly, with the left. When directed to look at an object distant about twelve inches, with both eyes open, the left eye turned directly downwards, or downwards and very slightly inwards. The right eye being covered, the left immediately came into position, showing a primary deviation of about two lines. The right eye being observed while the left was coming into position, the secondary deviation was seen to be equal to the primary, thus excluding the idea of any paralysis of the opposing muscle.

Testing the deviation.

Both eyes being uncovered, and he being told to look with the left eye only, the right eye was turned somewhat upwards.

Testing the condition of vision.

On testing his vision, I found that with the right eye he could read No. 23 Snellen, only at ten feet, and that no spherical glass corrected vision, $V=\frac{1}{2}$. With the left eye he could read No. 20 only at five feet, $V=\frac{1}{4}$; and no spherical glass corrected vision. By means of the stenopaic apparatus, however, I found that in the right eye he had "simple astigmatism," being "myopic" in the vertical meridian ($\frac{1}{50}$), and "emmetropic" in the horizontal meridian; and that a concave cylindrical glass, with its axis horizontal, enabled him to read perfectly at 20 feet. In the left eye he had mixed "astigmatism," being myopic $\frac{1}{50}$ in a direction midway between the vertical and horizontal meridians, while he was "hypermetropic" $\frac{1}{40}$ in a direction at right angles to this. A combination of two cylindrical glasses (−50) in the semi-horizontal direction, and (+40) in the semi-vertical direction, corrected vision up to fourteen feet—a certain amount of amblyopia from forty-five years of disease preventing his reading fluently at twenty feet.

Treatment by operation.

Taking into consideration that there was no paralysis, that diplopia could be produced by a prism, that vision could be corrected by suitable glasses, I saw no reason why an operation for the cure of the strabismus should not succeed, although it had existed for forty-five years! Accordingly, I placed him under chloroform, and divided the inferior rectus by the subconjunctival operation. There were no lateral expansions of the muscle, and the eye immediately righted itself, turning at first a little outwards; this, however, corrected itself after the first day. The eye is now quite straight, and all deformity is removed. When I last saw him, he had not received his astigmatic glasses, but I have no doubt that, when he gets them, he will not only be greatly improved in appearance, but will enjoy good vision.[*]

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[*] *Medical Times and Gazette*, vol. i. 1871, p. 243.

CHAPTER XV.

DISORDERS OF REFRACTION AND ACCOMMODATION OF THE EYE.

Myopia—Hypermetropia—Presbyopia—Astigmatism—Asthenopia: motor, and accommodatory.

Disorders of refraction and accommodation,

It is remarkable how few cases of impaired vision, due to anomalies in the refraction or accommodation of the eye, are met with among the lower classes in India. In fact, whole races of people appear to be actually strangers to these diseases. For instance, some years ago I was among the Sonthals, the aborigines of Bengal, dwelling in the Rajahmahal hills, and I took every opportunity of examining the eyes of the people I was brought in contact with, for the purpose of discovering if myopia and such like diseases existed among them; but I never yet saw a young Sonthal whose eyes were not emmetropic; the same remarks apply to nearly the whole of the lower classes in Bengal, with the exception of those living in Calcutta and other large towns, where overwork, sensual indulgence, and a polluted atmosphere have done a vast deal of harm to the physical as well as the moral eyes of the inhabitants.

rarely met with among some classes.

Focal adjustment of eye necessary.

It is an established fact that, for correct vision, rays of light which enter the eye from every point of an object under observation, must be brought to a focus upon the bacillar layer of the retina; it follows, therefore, that the healthy eye possesses an inherent power by means of which both finite and infinite rays are brought to a focus on the retina—that is, both divergent and parallel rays are made to converge to a point on its bacillar layer.* It is to the anomalies which occasionally exist in the human eye, with regard to its power of effecting these changes, that I would now draw attention. In the remarks I have to make on this subject I assume that the ciliary muscle is the active agent in altering the curvature of the lens. (See page 16.) Beyond the integrity of the ciliary muscle, the eyes require for perfect vision the faultless aid of the recti muscles, so that the posterior poles of each retina may be made to converge accurately on a given spot, and thus produce single vision by the use of two eyes. In an emmetropic eye the act of accommodation and of the convergence of the optic axes become habitually associated, so that it is difficult to exert either of them separately. Thus in looking at a near object, as in reading, the ciliary muscle contracts so as to increase the convexity of the lens, and at the same time the internal recti converge the eyes upon the letters of the book; in the normal eye the forces thus brought into play are perfectly adjusted and governed by branches of the third nerve: but in the hypermetropic eye, and also among persons suffering from myopia, there is a disturbance in the co-ordination of the converging and accommodating muscles of the eye, and hence under these circumstances the sense of fatigue which follows the long-continued use of the eyes.

Snellen's test types;

As I have before mentioned, Dr. Snellen's test types are those usually employed in determining the acuteness of vision. Some of these types are to be found at the end of this volume, and it may be useful to refer to the following rules laid down by Dr. Snellen in reference to their use:—

rules for their use.

I. The smallest angle, at which objects of known size and form can be distinguished, determines the degree of the relative acuteness of vision.

II. To determine the smallest visual angle, we measure the utmost distance at which objects of definite size can be recognised.

III. A visual angle and corresponding distance being taken as the unit of measure, the proportion between such distance and that at which the object is actually seen, expresses the acuteness of vision.

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* Finite rays are those proceeding from objects within sixteen feet of the eye, they are divergent rays, and their divergency increases in proportion to the proximity of the object under observation to the eye. Rays from a point situated beyond six feet from the eye are considered as being parallel to one another, and are called infinite rays.

IV. We take as unit for comparison the recognition of letters seen at an angle of five minutes.

V. The numbers placed above each type express in Parisian feet the distance at which the letters are seen at our standard angle of five minutes.

VI. The utmost distance at which the types are recognised (d), divided by the distance at which they appear at an angle of five minutes (D), gives the formula for the acuteness of vision (v).

$$v = \frac{d}{D}$$

Thus if d and D be found equal, No. XII. of the test types being recognised at a distance of 12 ft. $v = \frac{12}{12} = 1$; in other words, there is normal acuteness of vision. If, on the other hand, d be less than D, and if No. XII. be only visible within 6 ft. or VI. within 2 ft. or No. XXX. at 20 ft.

$$v = \frac{6}{12} = \frac{1}{2}$$
$$v = \frac{2}{6} = \frac{1}{3}$$
$$v = \frac{20}{30} = \frac{2}{3}$$

but d may sometimes be greater than D, and No. XII. be visible at a greater distance than 12 ft.; in this case the acuteness of vision is greater than the normal average.

VII. The normal acuteness of vision decreases with age (see Presbyopia).

VIII. The value of v should be found equal in testing with the different types, each at its corresponding distance. If such is not the case, and v appears to diminish considerably within or beyond a certain distance, it may be inferred that the refraction is at fault, or that the eye is not adjusted for such distance.

Selection of glasses.

With regard to the form of glasses to be used by patients suffering from myopia, or, in fact, from any disease of the eye requiring them, spectacles are far the best. They should be made to fit so that the glasses may be parallel with the patient's irides, and they should be placed as near the eye as possible, without allowing the cilia to brush against them when the lids are closed, except in cases of presbyopia, as I shall subsequently explain. The glasses with a spring fitting over the nose are generally objectionable for prolonged work, because the patient is apt to clap them on carelessly, sometimes close to the eyes, and at other times on the tip of the nose; moreover, they are frequently worn anything but parallel with the irides. An eyeglass is still more objectionable than the spring spectacles; binocular vision is ignored, and one eye only being used, the other may take to squinting outward.

With reference to lenses, the sign $-$ before a fraction signifies that the number indicated is a concave lens (negative focus); thus if we write $-\frac{1}{8}$ we mean concave lenses of eight-inch focal power. The sign $+$ (positive focus) before a fraction signifies that the lens mentioned is a convex one; $+\frac{1}{12}$ means a number 12 convex lens, or of twelve-inch focal power. The figure $\supset$ is the sign of combination, as in the case of a sphericocylindrical lens.

We make use of certain abbreviations in describing cases of faulty accommodation and refraction, such as C. M. corneal meridian; M. for myopia; Hm. hypermetropia; C. cylindrical glasses; S. spherical glasses. For example, a patient without glasses V. $\frac{20}{80}$ left eye, with $+\frac{1}{40}$ C. V.$=\frac{20}{20}$, and with ($+\frac{1}{40}$ S. $\supset$ $+\frac{1}{40}$ C.) reads fluently and without strain No. 2 S″, which means that without glasses the patient could read No. 80 of Snellen's test types with the left eye, at 20 feet; with convex cylindrical glasses* of 40-inch focal power, he could read No. 20 of Snellen's test types at 20 feet distance, and with a combination of number convex 40 spherical,† and convex 40 cylindrical lens he can read No. 2 of Snellen's test types at ordinary distance.*

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* A cylindrical lens is the segment of a cylinder, and refracts rays of light most in a plane at right angles to the axis of the cylinder of which it is a segment, whilst those rays of light which strike it in the plane of the axis, undergo no refraction whatever. For the sake of simplicity we may therefore restrict our consideration to these two directions—that of the axis and that of the transverse diameter. A 6-inch convex cylindrical lens means one which refracts a pencil of parallel rays thus: (1), those which strike it parallel to the transverse diameter of the cylinder are focussed at six inches from the surface of the lens; (2), those which strike it parallel to the axis of the cylinder are not focussed at all by the lens, but pass through it refracted not more than they would have been by passing through a piece of plain glass.

† A spherical lens is a segment of a sphere, and refracts the incident rays of light equally in all planes of the segment, so that spherical lenses are bounded by a spherical surface on one

Emmetropia.

EMMETROPIA.—By Emmetropia is meant the normal condition of the eye as regards its visual range. In this case, parallel rays of light are brought to a focus on the retina when the eye is at rest, and by a voluntary action of accommodation, divergent rays are also focussed on the bacillary layer of the retina; so that objects at all ordinary distances can be clearly and distinctly perceived, while the nearest point for distinct vision is at about four inches from the cornea. As a test of this condition, Snellen's types may be clearly deciphered at the respective distances assigned to them; and after the instillation of atropine, so as to paralyse the ciliary muscle, we find that the patient's long sight is hardly affected at all. I need hardly repeat that in the normal eye, the lens is passive when examining objects at a distance, consequently paralysis of the ciliary muscle only slightly affects the far point. Vision of distant objects is not improved either by convex or concave spectacles. The emmetropic eye can clearly define letters of small type at a distance of exactly 10 inches from a convex 10″ lens placed before the eye; for rays of light from the print fall under these circumstances as parallel rays on the eye.

Range of accommodation in health.

Myopia.

MYOPIA.—In Myopia, or short-sightedness, parallel rays of light are brought to a focus anterior to the retina, divergent rays alone being focussed on the retina. This condition may be induced by increased refractive power of the dioptric media, or more com-

Near objects alone distinct.

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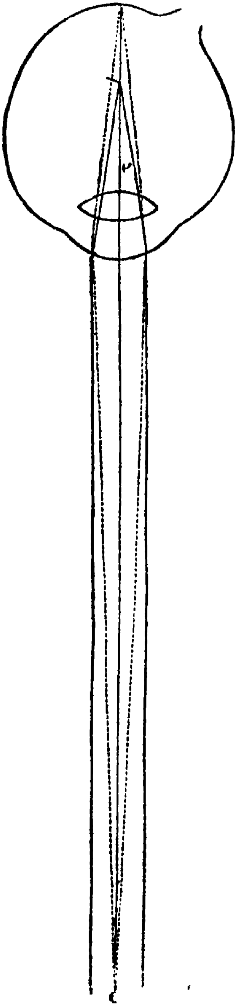
or both sides, they have the power of changing the direction of parallel rays of light passing through them, so that they cause the rays in the case of convex lenses to converge to a given point—the principal focus—or *the focus* as it is commonly called; or in the case of concave lenses, parallel rays of light diverge after passing through the lens, as if they proceeded from the principal focus.

* Works treating of ophthalmic subjects were formerly so encumbered with long words, that few people cared to study them; a reaction has however set in, several distinguished oculists have taken to describing their ophthalmic cases in a form of shorthand writing, which must unfortunately render their work absolutely incomprehensible, unless to those who had previously studied the characters employed by these authors.

monly by elongation of the eyeball in the antero-posterior axis.

FIG. 50.



Congenital or acquired.

Production of post. staphyloma,

Myopia is often congenital, but may arise from over-exerting the eyes upon minute objects, or by straining them in consequence of defective vision caused by opacities in the dioptric media. (See page 275.) Under these circumstances the accommodation of the eye is so much exercised, that in the course of time the lens assumes a permanently increased convexity, its refractive power is augmented, and myopia is the result. Whenever myopia is established, unless corrected by proper glasses, long-continued work induces hyperæmia and congestion of the internal tissues of the eye, especially of the choroid; and among those predisposed to suffer from a posterior staphyloma the disease is very apt to increase rapidly (page 378), a bulging of the sclerotic takes place posteriorly, so that the antero-posterior axis of the eye becomes elongated, and the rays of light are brought to a focus anterior to the retina. It is not that the point of intersection of the rays of light passing through the lens is in an abnormal position in this case, but the layer of rods and bulbs, is protruded backwards, so that the rays impinging on it form a dispersed circle of light (Fig. 50).

a common cause of myopia.

Posterior staphyloma is thus common among myopics; in fact, Von Graefe states that as a general rule, if a patient's far point does not exceed five inches, the myopia is due to that disease; and there can be no doubt that by far the greater number of cases of short-sightedness we meet with arise from this cause. As I have already described the phenomena, progress, and probable termination of posterior staphyloma, there is no necessity for my entering on a further examination of this cause of myopia. One cannot, however, too strongly impress on patients who may be suffering from that affection, the necessity of avoiding overworking their eyes, particularly in the stooping or lying posture; if they persist in this, it is evident that there is a constant strain on the eyes to keep up the necessary strong convergence of the eyes on a near object, and in addition the accommodative effort is considerable, so that the excessive forces thus called into play must produce congestion of the choroid, and with it an increase of the posterior staphyloma, or it may set up incurable disease in the vitreous or other tunics of the eye. Nor should such patients be allowed to read with the book or paper too close to them, for the posterior staphyloma is probably induced by the condition known as insufficiency of the internal rectus, in which an undue amount of pressure is exerted on the globe, during convergence of the optic axes, by the action of the obliqui; this tends directly to produce distortion of the globe, and augment the degenerative changes going on in the choroid (p. 376).

Preventive measures.

Diagnosis.

Diagnosis.—It would appear almost unnecessary to remark that when a patient consults us for shortness of sight, we should in the first instance ascertain if the case be one of simple myopia, or of some other form of disease inducing symptoms of a somewhat similar nature; nevertheless, mistakes too often arise through neglecting to make these necessary inquiries.

Myopia is characterized by objects at the near point of vision being distinctly seen, whereas those at a distance are very indistinct; but on placing a suitable pair of concave glasses before the myope's eyes, he at once defines distant objects with perfect accuracy, provided there be no impairment of vision in addition to the myopia. On the other hand, if the apparent shortness of sight arise from other causes, near objects will generally appear dim, and the far sight will certainly not be improved by concave glasses.

Effect of glasses.

Physiognomy.

The physiognomy of many myopes is peculiar; they are in the habit of almost closing their eyelids in distant vision; by so doing they cut off a number of the rays entering the pupil, and thus diminish the circles of diffused light which form on the retina (Fig. 50).

Cornea seldom very convex.

It is an error to suppose that as a general rule those suffering from myopia have prominent corneæ. Donders states that the reverse of this is usually the case, though no doubt conical cornea may give rise to short-sightedness.

The ophthalmoscope as a test.

If the eye of a person suffering from myopia be examined with the ophthalmoscope (the direct method of examination being employed), in consequence of the augmented refractive power which exists in the dioptric media, or the lengthening of the eye which is equivalent to it, and which is in fact the cause of the disorder, the rays of light converge immediately after emerging from the cornea; they cannot, therefore, be brought to a focus on the observer's retina, so as to present a clear erect image, however near his eye be approximated to that of the patient; it is only when diverging, after intersection, that they are fitted to produce distinct vision, the image being necessarily an inverted one. In a myopic eye an erect image cannot be seen by the direct method of examination, unless a concave lens be interposed between the eye and the ophthalmoscope; but at a distance of some fourteen inches an inverted image will be distinctly visible without a lens. That the image is an inverted one, may be proved by the observer moving his head either to the right hand or the left, when the object under examination will appear to move in a precisely opposite direction.

No erect image seen;

but an inverted one without a lens.

If, therefore, on examining a person's eye by the direct method, a clear, enlarged, and inverted figure of the retina be seen at a distance of fourteen or fifteen inches from the eye, it may with safety be affirmed that the individual is myopic; and this diagnosis will be confirmed, if it be found impossible to see an erect image, however close the ophthalmoscope be brought to the patient's eye.

Diagnosis. By test types.

If the myopia does not exceed $\frac{1}{24}$, the patient will be able to read Nos. 1 and 2 of Snellen's test types at one and two feet from the eyes; but he will be unable to see clearly beyond twenty-four inches, and hence cannot make out the larger test types at the distances indicated by the figures placed above them. If the degree of myopia be higher than $\frac{1}{12}$, then No. 1 of S. will not be read at one foot, and the furthest distance at which the types can be distinctly read will indicate the probable degree of the myopia.*

To determine the degree of myopia,

find excess of refraction

with a convex lens.

To Determine the Degree of Myopia.—The system adopted in examining recruits for the army is certainly, as Professor Longmore remarks, one of the most easily applied means of determining the degree of myopia. One eye must be examined at a time; the other being closed, or still better screened from the light. Our object is to discover the excess of the refracting power of the eye under examination, as compared with an emmetropic eye. In describing emmetropia, I mentioned the fact that with a + 10″ lens placed before the eye, it would be able to read small type at 10″ from the lens, for under these circumstances the light coming from the print would fall as parallel rays on the eye. But if this same + 10″ lens is placed in front of an eye affected with myopia, evidently in consequence of its excessive power of refraction, the eye will be unable to define the print at 10″; but let us suppose that by bringing the print to a distance of 6″ from the lens the letters can be clearly seen; the difference between a + $\frac{1}{6}$ and a + $\frac{1}{10}$ lens is the measure of the excess of the refracting power of this eye:—

$$\therefore M = \tfrac{1}{6} - \tfrac{1}{10} = \tfrac{1}{15},$$

and a 15″ concave lens will neutralize the + $\frac{1}{15}$ of excess of refractive power in this particular instance.

Determination of the focal length.

Another method of determining the degree of myopia is as follows:—It is first necessary to ascertain what is the furthest distance at which the patient can read No. 1 of Snellen's test types; in fact to determine the distance of his "far point." Suppose he can clearly define No. 1 up to ten inches from the eye; this being his far point, he will require a concave lens of ten-inch focal length, which, by the dispersive power it possesses, will counteract the excessive refractive power of his eye, enabling him to bring parallel rays to a focus on his retina, and thus correct the existing myopia. No. 10 concave glasses would, however, under these circumstances, be too strong, because the convergence of the optic axes at ten inches is such as to prevent the eye exactly accommodating itself for distant objects with parallel optic axes; consequently 10 is not precisely the power best adapted to the case, and this may be ascertained by first placing a concave and then a convex glass before the lens; should the former improve the sight, 10 will not be sufficiently powerful to neutralize the myopia; if, on the other hand, a convex lens improve the sight, 10 is too strong a glass, and we must try a weaker one; but should neither concave nor convex glasses improve the sight, we may depend upon this being the power necessary to correct the existing myopia. As a rule, the weakest glasses which neutralize the myopia may be given.

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* "Manual of Instructions for Guidance of Army Surgeons in Testing the Range and Quality of Vision." Second Edition, p. 16. By Surgeon-General T. Longmore, C.B., Professor of Military Surgery, Netley School.

Illustration.

Supposing a person suffering from myopia which is overcome by $-\frac{1}{12}$ lens for distant objects, and he requires glasses to enable him to see music or print at 24′, we shall be able to discover the necessary glasses as follows: $-\frac{1}{12}+\frac{1}{24}=-\frac{1}{24}$: hence a − 24 lens will render objects clear at 24″.

Myopia measured by ophthalmoscope.

Lastly, we may form an approximate idea of the degree of M. by means of the ophthalmoscope; for, as I have already explained, we can get an erect image of the fundus of a myopic eye, if we place the ophthalmoscope very close up to the patient's eye; but to obtain an erect image beyond the point at which the converging rays cross, we must fix a concave lens behind the sight-hole of the instrument; and the strength of this correcting lens will enable us to form an idea of the degree of myopia from which the patient is suffering; *provided that in making the examination we can ignore the fact that we are looking at a near object, and use no accommodative effort,* so as to allow parallel rays of light to be focussed on our retina. The reason of this is, that if we advance the ophthalmoscope sufficiently near to the myopic eye, we shall receive from it converging rays which will form an erect image on our retina. But beyond the point at which these converging rays cross one another an inverted image would be focussed on our retina, unless the converging rays are rendered parallel by means of a concave lens placed in front of our own emmetropic eye.

Accommodation must be suppressed.

The weakest concave lens, therefore, which renders these converging rays parallel, so as to enable us without any accommodative effort to observe an erect image of the patient's retina, will give us an idea of the existing myopia.

Choice of glasses

CHOICE OF GLASSES.—In selecting glasses for a patient suffering from M., we must examine first one eye and then the other; if we find that the refractive power of the eyes differs, we should order glasses which will neutralize the defect in the eye which suffers least from myopia; it is not advisable under these circumstances to attempt to overcome the faulty sight in both eyes by supplying the patient with spectacles the lens on one side being stronger than that on the other side. For instance, a patient comes to us affected with M.: we place him twenty feet in front of Snellen's test types from No. CC. to XX., and find that he cannot define any of the letters; we then direct him to walk slowly up towards the test types, and discover that he can see No. XX. at 10′ from the test object with the right eye, but he can only see the same type at 9′ distance with the left eye; our object will be to supply him with glasses which will neutralize the excessive refraction of the right eye, and this may be done by means of a + 10″ lens, or by measuring the furthest point at which he can read No. 1 type, as above described; having by either one or both these methods found out the concave glass which neutralizes the existing M. in the right eye, he should with this lens be able to decipher clearly the letters from No. CC. downwards, at the respective distances at which they can be defined by an emmetropic eye.

for least affected eye.

Example.

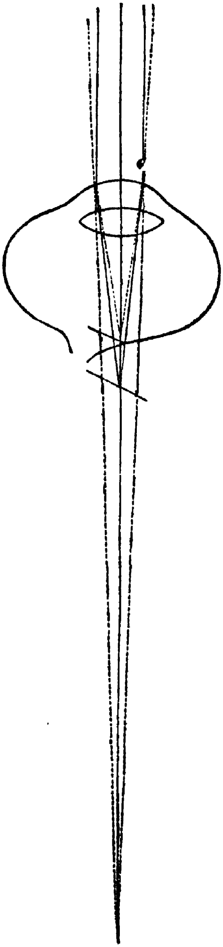
HYPERMETROPIA.

HYPERMETROPIA.—Hypermetropia is a defect of vision depending on a want of refractive power in the dioptric media, or else on a shortening of the antero-posterior axis of the eyeball, so that, during repose of accommodation, parallel rays of light which enter the eye, converge towards a point behind the retina, and convergent rays alone can be brought to a focus upon the retina. The consequence is, that the hypermetropic eye is obliged to exert its accommodating power to bring rays even from distant objects (parallel rays) to a focus on the bacillar layer; and for near objects

Rays converge to a point behind retina.

(divergent rays) this effort has to be considerably increased, so that both the far and near points of vision are disturbed (see Fig. 51).

FIG. 51.



Often no marked symptoms.

Hypermetropia (H.), like myopia, is often an hereditary affection, and exists therefore in several members of the same family. H. may not be attended by any very striking symptoms; the patient's sight is imperfect, but by an effort of accommodation he can generally so far overcome the defect as to be able to perform all ordinary work; but the hypermetropic eye cannot quickly adjust itself for far objects, as in shooting. Sooner or later, however, symptoms of *asthenopia* supervene, the words which a person suffering from hypermetropia happens to be either reading or writing appearing to run into one another, becoming very indistinct; distant objects are also confused, so that in fact the patient's sight becomes exceedingly defective: nevertheless it may be good enough to define large objects, and even small ones in a clear light and for a short time. We can hardly be too cautious in attending to the complaints of children when suffering from what are often called weak eyes, for in very many such instances the real cause of the defective vision is hypermetropia, and the inability of the child to define letters induces asthenopia and a congested and painful condition of the choroid and even of the conjunctiva.

Asthenopia in time.

From straining of accommodation.

The immediate cause of this state of things must be sought in the straining to which the accommodatory mechanism of the hypermetropic eye is exposed, in order to increase the convexity of the anterior surface of the lens, so as to compensate its deficiency of refracting power, and to correct, in some measure, the hypermetropia. After a time the patient can no longer maintain the accommodatory effort which is necessary for this purpose, and hence the symptoms above noticed (asthenopia).

Congenital.

Hypermetropia may arise from congenital malformation of the eyeball, its antero-posterior axis being shortened; or the same result may follow from *aphakia*, that is, absence of the crystalline lens. Under these circumstances, we can readily understand that rays of light passing through the dioptric media cannot be brought to a focus on the retina, unless, indeed, the focal distance be shortened by means of a convex lens held in front of the eye. H. sometimes appears when persons have reached about fifty years of age, it comes on with presbyopia, and seems to be due to senile degeneration: this form of H. has been designated as *acquired* H., to distinguish it from *original* H. due to congenital defects in the formation of the eyeball.

Complicated with strabismus.

It is by no means an uncommon circumstance to meet with cases of hypermetropia complicated with strabismus; this is explained by the fact, that when a person is using his eyes for near vision (divergent rays) the action of the internal recti in causing the optic axes to converge upon the object under examination, is accompanied by a corresponding automatic action of the ciliary muscle, to produce the requisite amount of accommodation. In hypermetropia the convergence no longer corresponds with the accommodation required; but the hypermetropic patient unconsciously avails himself of this natural association of movements, and assists the sustained action of the ciliary muscle, which is necessary for distinct vision, by an extraordinary exertion of the internal recti.* But, as Pro-

Accommodation aided by convergence.

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* "There exists a certain connexion between accommodation and convergence of the visual lines; the more strongly we converge, the more powerfully can we bring our faculty of accommodation into action. A certain tendency to increased convergence, so soon as a person wishes to put his power of accommodation upon the stretch, is therefore unavoidable."—"On the Anomalies of Accommodation and Refraction of the Eye," by F. C. Donders: translated by W. D. Moore, p. 291, 1864.

fessor Longmore remarks in the case of a person suffering from H., the patient can only accommodate his vision to a point beyond the intersection of the visual axes, and consequently double vision would result, if both eyes were equally directed towards a near object. One eye therefore becomes the working eye; the other, in order to overcome the inconvenience of diplopia, deviates from its natural position, so that the rays of light from the object under observation fall on the outer or less sensitive part of the retina, and are ignored by the patient, the constant disproportionate action of the internal recti for these purposes becomes habitual and leads to acquired strabismus. As the strabismus becomes more confirmed, the functions of the retina grow weaker, and at length may be completely destroyed.

Tenotomy and glasses required.

In the earlier stages of the disease, when the strabismus is intermittent, it may be corrected by the use of convex glasses to neutralize the hypermetropia, but in the majority of cases it is necessary to divide the internal rectus; this operation should be performed as soon as possible, for otherwise the sight of the squinting eye may become materially impaired; the image formed upon it being ignored by the sensorium, and the nervous apparatus not being exercised, atrophy of the retina ultimately ensues. After tenotomy, it is absolutely necessary that the patient should be supplied with glasses to neutralize the hypermetropia.

Ophthalmoscope in hypermetropia.

Diagnosis.—In a case of hypermetropia, in consequence of the defect in the shape of the eyeball, or in the dioptric media, parallel or divergent rays entering the eye would, if prolonged, converge to a point behind the retina (Fig. 51); and conversely, rays reflected from any point in the retina will, on emerging from the eye, proceed as if they came from a virtual image of the point situated behind it; and being divergent they may be brought to a focus on the observer's retina and form a distinct image at a distance of fourteen or fifteen inches. That this

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* "Manual of Instruction for the Guidance of Army Surgeons in Testing the Vision of Recruits." By Professor Longmore. Second Edition, p. 21.

Erect image seen at fourteen inches;

image is an erect one, may be ascertained from its moving in the same direction as the observer's eye; for instance, if the optic disc be the object under examination, and the observer turn his head to the right, the disc will follow to the right also.

In emmetropia, at three or four;

If the direct method of examination be employed in the case of an *emmetropic* eye, an erect image of the retina may be clearly defined at a distance of three or four inches, but only a very imperfect one can be seen at fourteen or fifteen.

In myopia, inverted.

In the *myopic* eye, an erect image cannot be seen at all, but at about fourteen inches, a well-defined inverted figure may be observed.

In the *hypermetropic* eye, an erect image of the retina may be seen at a distance of fourteen or fifteen inches.

Diagnosis of erect and inverted images.

The diagnosis in these cases may be much assisted by the following plan, proposed by Mr. G. Cowell:—"A finger of the hand not employed in holding the ophthalmoscope, is held up as an object for the patient to fix with the eye under examination, and in such a position that the observer may get an image of one of the retinal vessels. If the finger be then slightly moved to and fro, in a direction perpendicular to the vessel, the image will be seen to move with the finger when myopia is present, and in the opposite direction when the eye is hypermetropic."*

Flattening of eyeball.

If the hypermetropia arise from the eyeball being flattened from behind forwards, as it generally does, it may be detected by making the patient turn his eye inwards, when the peculiar flattened form of the globe will be noticed.

Far and near vision imperfect.

If we test the sight of a person suffering from hypermetropia with Snellen's types, we shall find that there is considerable imperfection of vision at both the near and far points; the larger types are proportionately better seen than the smaller ones, which the patient will naturally hold very close to his eyes, so as to gain the full advantage which the convergence of the optic axes affords him of increasing the power of accommodation, and also of enlarging the retinal image.

In looking at objects at a distance, as, for instance,

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* *Ophthalmic Hospital Reports*, vol. v. p. 227.

No. XX. Type, at twenty feet from the eye, although the letters may be clearly defined at first, the accommodatory apparatus being brought into play to focus even parallel rays, the strain on the ciliary muscle soon becomes greater than the patient can bear, and its tension giving way, the letters become indistinct, and a tendency to internal strabismus is observed. If suitable convex glasses be now placed before the patient's eye, all these symptoms disappear, the rays of light being brought to a focus upon the bacillary layer of his retina; and this, in fact, is the correct mode of treatment in cases of this kind. It is quite possible that H. may be mistaken for M., for the far point is indistinct, and small type has to be brought close to the eye to enable the patient to define it clearly: but convex glasses placed before the eye of the hypermetropic patient at once renders diagnosis clear, the sight in H. becoming distinct, but in M. more indistinct.

Corrected by convex glasses.

Three degrees.

Donders divides hypermetropia into three kinds:—

1. Facultative.

1. *The facultative;* in which the patient is able to see well (with parallel optic axes) at infinite distance, with or without the aid of convex glasses, and his sight is generally sufficiently acute to enable him to read small print; but after a time symptoms of asthenopia arise.

2. Relative.

2. *Relative hypermetropia;* in this form, the accommodation and range of vision are also good, but the patient is obliged to assist the action of the ciliary muscle by the internal recti, converging the optic axes on some point nearer than the object he is looking at, and he thus acquires an internal squint. The sight is always more or less defective.

3. Absolute.

3. *Absolute hypermetropia;* in which vision is very indistinct both for near and far objects, the patient not being able to focus rays of light on the retina, however great the effort of accommodation, combined with the strongest convergence of the optic axes. On a superficial examination such a person might be mistaken for one suffering from amblyopia.

Hypermetropia may be *manifest* or *latent* (M. H.) and (L. H.). In cases of hypermetropia parallel rays of light not being brought to a focus on the retina the aid of the ciliary muscle is called into play, in order to increase the refractive power of the eye, even when employed on distant objects. And for near objects there is a still greater effort of the accommodatory power necessary: the consequence is that in the course of time in every act of vision the ciliary muscle is brought into play until its action becomes an involuntary one; and in examining a case of H. we must take this fact into consideration, for in every effort of vision we have to deal with H. + the increased action of the ciliary muscle, and to discover the actual amount of H. in any given case, we must destroy the action of the ciliary muscle, paralysing it by means of a solution of atropine applied to the conjunctiva. Hypermetropia therefore consists of a certain amount of deficiency in the refractive powers of the eye which is *manifest* on an ordinary examination; but a further amount of defective refractive power also exists which is concealed by the action of the ciliary muscle, this is the *latent* hypermetropia. The total amount of hypermetropia in any given case therefore is constituted of H. M. + H. L.: and if the degree of H. is small, it may be entirely latent or overcome by the action of the ciliary muscle, so that it is not until this muscle is paralysed that we discover the H.; in cases, however, of this kind the sight is not only defective but becomes much more so if the tone of the muscular system is under par, or if the eye is over-worked and the ciliary muscle unable to bear the fatigue gives way and asthenopia results.

Measure degree of H.

Paralyse accommodation.

To determine the degree of hypermetropia only one eye should be examined at a time, having completely paralysed its ciliary muscle by means of atropine: a solution of four grains to the ounce of atropine should be applied to the eye night and morning the day before the examination is made. We must ascertain the deficiency of the refractive power of the eye as compared with that of an emmetropic eye. As I have already remarked in the case of M., if a + 10″ lens is placed before an emmetropic eye the patient will be able to define print clearly at 10″ from the lens, because the rays of light under these conditions fall as parallel rays on the observer's eye. But if this same + 10″ lens be placed in front of an eye affected with H., in which the accommodation has been paralysed, it is evident that in consequence of its defective refraction the patient will be unable to define print at 10″ from the lens, but he may be able to see the test type clearly at 15″. Under these circumstances the difference between a

Use of convex lens.

$+\frac{1}{10}$ and $+\frac{1}{15}$ lens measures the deficiency in the refractive power between the emmetropic eye and the eye affected with H.; consequently

$$H = \frac{1}{10} - \frac{1}{15} = \frac{1}{30}$$

and a $+\frac{1}{30}$ lens should enable the patient to overcome the defect in the refractive power of the eye from which he suffers.

Atropine not always necessary.

In cases where the amount of H. is small, it may not be necessary to overcome the latent H.: we may be able by means of the test above described to discover the degree of manifest hypermetropia as compared with that of an emmetropic eye, and having neutralized this defect in its refractive power by means of a convex lens, the patient's sight, with the aid of his glasses, will be perfectly good for all practical purposes.

Test types.

I have already referred to the diagnosis of the degree of H. by means of test types; I have only to allude therefore to that of the ophthalmoscope as an instrument by which we can not only determine the existence of H., but also form an idea of its degree.

Ophthalmic test of degree of H.

The difficulty in this case, as in that of M., arises from the fact that the observer must, while looking at a near object, prevent his ciliary muscle from acting—that is, he must, while examining the H. eye, prevent his eye from accommodating itself for a near object. The reflected rays of light from the fundus of an hypermetropic eye are divergent according to the degree of hypermetropia, and an emmetropic eye with its accommodation suspended can only obtain a clear image from parallel rays;* but if we place a convex lens behind the sight-hole of the ophthalmoscope, so as to render these divergent rays parallel, provided we can prevent our ciliary muscle from acting, the parallel rays reflected from the fundus of an hypermetropic eye will be brought to a focus on our retina, and enable us to obtain an erect image of any small vessel in the region of the yellow spot; the power of the convex lens, which converts the divergent into parallel rays, will under these circumstances give us an idea of the degree of H. existing in the case under examination.

SELECTION OF GLASSES IN CASES OF H.—I have

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* "A Practical Treatise on Diseases of the Eye." By R Brudenell Carter, F.R.C.S. Macmillan, 1875. Page 550.

Selection of glasses.

already referred to the means by which we ascertain the degree of H. and the power of the lens necessary to overcome the diminution in the refractive power of the eye; but in practice we shall find that from long-continued action, it is difficult to prevent the ciliary muscle from exerting itself too powerfully on the lens, so that in order to ascertain the glasses necessary to correct the defect of vision in a case of hypermetropia, the patient should be directed to read No. 20 of Snellen's test types at a distance of twenty feet; this he will probably be unable to do without the aid of convex glasses. Supposing that with No. 30 he reads this sized print clearly, it will then be necessary to destroy his accommodating power with atropine, and this having been done, we find, perhaps, that he now requires No. 20 convex glasses to define the same letters; but as he cannot overcome the habit of over-using his ciliary muscle, we must make allowance for this, and strike the difference between the lenses necessary to overcome the M.H. and the L.H., and supply our patient with No. 24 or No. 26 convex glasses. We may further test their defining power, by placing first a convex and then a concave glass in front of his spectacles.

Danger of retinal hyperæmia.

We sometimes meet with cases of hypermetropia, in which there is considerable hyperæmia of the retina, induced by constantly overstraining the eye; and if this condition has lasted for some time, the nervous apparatus will be more or less damaged, and imperfect vision must be a permanent result. The patient's sight, however, may be considerably relieved by the use of convex glasses, unless irreparable damage has been done to the nervous tissue.

Glasses always to be worn.

Whatever glasses we may order, it is necessary that the hypermetropic patient should wear these constantly, otherwise it is impossible to overcome the tonic contraction of the ciliary muscle: at first he may find the spectacles inconvenient, but we must insist on their being worn from morning till night; and it matters not what the age of the patient may be, so soon as we discover that he suffers from H., our course of action is clear, for properly-adjusted convex glasses can alone overcome the defect of vision from which he suffers.

H. in cases of extraction of lens.

Hypermetropia, as I have before remarked, is found to an extreme degree after the removal of the lens, the condition called "aphakial" existing; in fact, the power of accommodation is destroyed, and we must supply our patient with glasses for seeing near and far distant objects. As a rule, a + 3½ or + 4 lens will best enable such a person to see distant objects, and he may require a + 3 or perhaps + 2½ lens to define letters with. In consequence of the weight of these powerful lenses, plano-convex glasses are often useful; and we can only determine the power of the lens required by trying glasses of various strength, and noting the ones with which the patient sees best. The smaller the pupil after extraction, the better as a rule will be the defining power of the patient, and the power he has of judging of distance accurately: I have seen a person after the operation of extraction has been performed on both eyes, play a very good game of billiards with + 3 glasses, the pupils being not larger than they would have been when extremely contracted in the healthy eye.

Small pupil desirable.

The distinctions between the various affections of the eye I have been considering, are well shown in the following table, taken from Mr. J. Z. Laurence's work on the *Optical Defects of the Eye*, p. 30.

Tabular view of optical defects.

The Eye in a State of Rest (=Crystalline at its Minimum Curvature; Optic Axes Parallel).

1. Eye:—	2. Parallel rays are focussed:	3. Far point:	4. Eye in a state of rest adapted for:	5. Effect of glasses for distant objects:—
I. Normal.	*On* the retina.	At an infinite distance.	Parallel rays.	Convexes and concaves deteriorate vision.
II. Myopia.	In *front* of the retina.	At a definite distance and positive.	Divergent rays.	Concaves improve vision.
III. Hypermetropic.	*Behind* the retina.	At a definite distance and negative.	Convergent rays.	Convexes improve vision.

PRESBYOPIA.
Failure of accommodation.

PRESBYOPIA.—Presbyopia consists in a defect in the accommodating power of the eye, arising from alterations in the fibrous structures of the lens, which prevent the convexity of its anterior surface from becoming increased in correspondence with the contractile power exercised by the ciliary muscle; and, in consequence, the near point of sight for small objects is removed to a distance of not less than eight inches from the cornea: while rays from distant objects are still brought to a focus on the retina. Presbyopia may be brought about by glaucoma, in consequence of changes in those parts of the eye which influence the act of accommodation; but in an uncomplicated instance of presbyopia, the focal error is completely corrected by applying a suitable convex lens in front of the eye, so as to compensate for the loss of refractive power in the eye caused by changes in the lens.

Near point recedes with age.

The alterations which result in presbyopia may be said to commence from the age of twenty years, when the near point begins to recede. At five-and-forty, its distance from the cornea is usually upwards of eight inches; the eye is then pronounced to be presbyopic, and as the patient experiences, for the first time, some little inconvenience in reading and writing, he probably applies for relief. His far point, however, remains unaffected; for, as I have repeatedly stated, the lens and ciliary muscle are passive when objects at a distance of twenty feet or upwards are under examination.

Far point unaltered.

Convex glasses for.

Presbyopia, as I have before remarked, may be completely neutralized by proper lenses, and we should invariably insist on those suffering from this defect of vision using convex glasses, which will enable them to read No. 1 of Snellen's test types at twelve inches from their eyes without fatigue. The spectacles should be worn so that the patient may look over them when using his eyes for distant objects; and as a general rule the weakest glasses which enable a patient to read No. 1 type at twelve inches distance from his eyes should be given. In the majority of cases No. 36 or 40 convex glass will be strong enough to overcome the presbyopia in its early stages: as the patient grows older he will require to increase the focal power of his spectacles.

Presbyopia may exist with myopia, but will not be perceptible so early in life as it would be in the case of an emmetropic eye; and if the M. amounts to $\frac{1}{8}$, the presbyopia cannot exist, because the near point cannot be removed beyond 8″ from the eye. But if the M. is only slight, then as age advances the patient may require concave glasses to enable him to see distant objects, but he will also require convex glasses to enable him to overcome the deficiency of the accommodation necessary to make out small objects near the eye.

Presbyopia and myopia.

Presbyopia again may be present with H., and although the latter affection may have been overcome by means of proper glasses, nevertheless as the hypermetropic patient advances in age he can no longer accommodate for near objects such as in reading and writing, and we must therefore add such power to the lenses as will enable them to overcome this want of action in the lens. Thus a person who has worn + $\frac{1}{12}$ glasses to overcome his H. will probably at forty-five years of age require a + $\frac{1}{36}$ lens added to his $\frac{1}{12}$ to enable him to read with comfort ($\frac{1}{12}+\frac{1}{36}$) = $\frac{1}{9}$ or a + $\frac{1}{9}$ lens; but on leaving off his reading he would require the $\frac{1}{12}$ lens for distant objects. To obviate the necessity for constantly changing his spectacles, Franklin devised the plan of putting two half-lens in each ring of the spectacle frame: the upper half being the weaker, for distance, the lower half the stronger, for reading. Glasses of this kind are useful in cases such as that above noticed.

Franklin's plan of lenses.

ASTIGMATISM.

Unequal refraction in different meridians.

ASTIGMATISM.—By astigmatism is meant, a condition of the dioptric media, such that the refractive power of the eye varies in its different meridians, so that in one plane it may be emmetropic or hypermetropic, and in another plane myopic, and so on; the consequence is, that rays emanating from one point, are not reunited into one point after traversing the eye, and thus a very imperfect image of any object under observation is formed on the patient's retina: under these circumstances a person complains of the letters or words he may be reading being indistinct; in the effort which he makes to accommodate, first for one meridian and then for the other in order to obtain clear vision, the ciliary muscle becomes strained and asthenopia is the result.

Near vision confused.

Symptoms.

It is obvious that the more widely dilated the pupil is, the greater will be the fault in the refraction of the rays of light passing through the dioptric media of an eye affected with astigmatism: but the acuteness of vision, as I have before remarked, for both near and distant objects is lessened, so that in reading the letters appear blurred, the difficulty of defining the print increasing after the eye has been exercised for some time, in consequence of failure in the ciliary muscle to act on the lens. Objects at a distance of ten or fifteen feet, such as the woodwork of a window-frame, is distorted, the horizontal bars being more clearly defined than the vertical ones, or *vice versâ*. It is in fact easy to understand the deformity which must arise in the outline of all figures, when looked at through a cornea in which the rays of light passing through the horizontal, are refracted differently from those passing through its vertical meridian.

Objects blurred.

Ill-defined.

Causes.

Astigmatism is frequently a congenital affection, the curvature of one meridian of the cornea being greater than that of another meridian. But inflammatory changes in the cornea may induce similar results; and there can be no doubt that inequalities in the curvature of the anterior surface of the lens, as well as structural changes in the cortical walls of the lens, may cause astigmatism.

Three varieties of astigmatism.

Donders has divided astigmatism into three kinds:—

I. *Simple astigmatism*, in which the principal meridian is emmetropic, the other being myopic or hypermetropic.

II. *Compound astigmatism;* either myopia or hypermetropia existing in both of the principal meridians, but differing in degree in each.

III. *Mixed astigmatism*, in which one of the meridians is myopic while the other is hypermetropic.

Diagnosis.

Diagnosis.—Neither concave nor convex spherical lens will materially remedy the defective vision caused by astigmatism.

By test lines.

Probably the most simple and effective method of diagnosing cases of astigmatism is by means of Snellen's half circle of radiating lines, together with a combination of + and − spherical glasses. A patient comes to us with suspected astigmatism; we place him with his back to the light and with Snellen's fan of radiating lines, hung at 20″ in front of, and on the same level as his eyes. Each eye must be examined separately. We find that with the right eye he can see the vertical lines of the fan clearly, the

Example.

inclined lines only dimly, and the horizontal lines hardly at all. On placing a $-\frac{1}{24}$ spherical lens before the eye the horizontal lines become clear, but the vertical rays are thus rendered indistinct. Evidently in this case the vertical meridian of the eye was emmetropic, but the horizontal meridian was myopic to the extent of $\frac{1}{24}$.

In the left eye with a $-\frac{1}{9}$ lens the inclined ray of the test fan, 70°, which was previously dim, came out quite clearly, and with a $-\frac{1}{36}$ placed in front of the $-\frac{1}{9}$ the line $-20°$, previously dim, was clearly defined, so that the corneal meridian corresponding to line 70° in the fan is myopic to the extent of $-\frac{1}{9}$, and the meridian of line $-20°$ is myopic to the extent of $\left(\frac{1}{9}+\frac{1}{36}\right)=\frac{5}{30}=\frac{1}{7\frac{1}{5}}$.

In fact, having by means of Snellen's radiating lines discovered that the meridians of the eye differ in their refractive power, we must set ourselves to work to discover if + or − glasses overcome the defect in the acuteness of vision in the affected meridian. It may be as in the example given above (the right eye) that one meridian is emmetropic, and the other myopic (myopic astigmatism), or as in the left eye that the degree of M. differed in different meridians (compound myopia astigmatism), M. H. may be found in one meridian and emmetropia in another (hypermetropic astigmatism), the degree of H. is noted, and so on. But in cases of A. H. it will often be necessary as in simple H. to paralyse the ciliary muscle before we can properly determine the deficiency in the refractive power of the eye.

Tests of astigmatism.

The ophthalmoscope.

Several very ingenious methods have been invented to test the amount of astigmatism in any particular case; among these the ophthalmoscope holds a prominent position, and it affords the means not only of detecting astigmatism, but also of determining its degree, and the plane in which it is situated. A concave mirror of thirty inches focus should be employed, the fundus of the eye being illuminated at a distance of five feet, the accommodation of the eye under observation having been paralysed with atropine. The patient should then be directed to follow the movement of the surgeon's finger in a horizontal and vertical direction; an inverted or an erect image becoming alternately visible according as the observer views the fundus of the eye through the meridian of the greatest or least curvature.

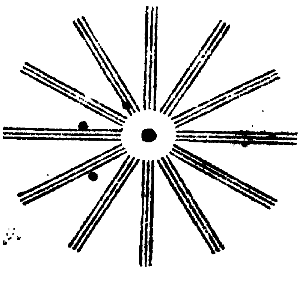
Chromatic test. If a person whose eye is healthy, be directed to look through a plate of violet-coloured glass, fixed in a black screen, the glass will appear to be surrounded with a red rim; this is accounted for by the different refrangibility of the rays of light. In the case of astigmatics, the refraction seems to be completely altered: for if the above experiment be repeated upon a patient suffering from this form of disease, the vertical meridian being myopic and the horizontal hypermetropic, the opening in the screen will appear surrounded above and below by a blue rim, and on either side by a red one.

Distortion of visual images. Another method of ascertaining the existence of astigmatism, is to place the patient at a distance of 12 or 16 feet from a bright spot of light, upon which he is directed to keep his eye steadily fixed, looking at it through a round hole in a screen; if the eye under examination is astigmatic the bright spot will appear to be elongated, according as the light is nearer or further off than the point for which the eye is accommodated.

If the eye is accommodated for a further point and the maximum curvature of the cornea coincides with the vertical meridian, the luminous spot will appear horizontal, but vertical if the eye is accommodated for a near point.

Green's test. Dr. Green's method of testing an eye for astigmatism is as follows. A figure such as that here depicted is drawn, each line being equal in thickness to those employed to form the letters of Snellen's No 20 test types. This test is placed 20 feet from the patient's eyes, and while he fixes his eye on the central spot, if he be astigmatic, the radiating lines in one meridian only will be distinctly seen, those corresponding to the meridian of lowest refraction being dimly if at all distinguishable. We may further, by means of this figure, ascertain the degree and nature of the astigmatism

FIG. 52.



by cylindrical glasses of a certain power rendering the whole figure distinctly visible, in fact overcoming the defective refractive power of the cornea.

It has been stated that the inverted image of the optic disc of an astigmatic eye, viewed by the ophthalmoscope, is elongated, so that the long axis corresponds to the meridian of least refraction. Dr. Hay shows that this is not uniformly true; that the form of the nerve-image depends on the distance at which the objective lens is held from the eye. If we suppose the lens to be of three inches' focus, and held about three inches from the eye, the nerve will appear circular notwithstanding the astigmatism; that if the lens be held nearer than three inches, the image will be oval, and the long axis correspond to the meridian of least refraction; if the lens be held farther than three inches, the image will be oval, and its long axis correspond to the meridian of greatest refraction.

If a minute hole be drilled in a piece of metal, and held close to an emmetropic eye, accommodated for distant vision, the spot, instead of appearing round, looks as if it were star-shaped; that this is due to the lens, is proved by the fact, that when the lens is removed no such appearance is produced, and if the cornea be neutralized by holding the eye open in a small vessel of water, bounded by a convex glass side, the hole appears still to be star-shaped, provided the lens is *in situ*.

Different sectors of lens give different images.

Donders explains this fact by reference to the anatomy of the lens, which is divided into sectors by its fibrous bands, each sector forming a separate image. He further demonstrates it by moving a small opening in a metallic plate before the eye; "when the opening comes in front of the boundary between two sectors, two faint images appear, of which, on further displacement, the first seen disappears, while the one which has supervened remains alone and brighter." If, therefore, there be any abnormal condition in these sectors of the lens, we can readily understand that it must interfere with the perfection of vision; more particularly as the rays of light passing through each sector are subject to the laws of spherical aberration.

Treatment.—Astigmatism may be corrected by pro-

Cylindrical glasses.

Refract unequally in different planes.

perly adapted *cylindrical lenses.* Mr. J. Z. Laurence remarks that "A spherical lens is a segment of a sphere, and refracts the incident rays of light equally in all planes of the segment; a cylindrical lens is the segment of a cylinder, and refracts rays of light most in a plane at right angles to the axis of the cylinder of which it is a segment, whilst those rays of light which strike it in the plane of the axis, undergo no refraction whatever. For the sake of simplicity we may therefore restrict our consideration to these two directions—that of the axis and that of the transverse diameter. A 6-inch convex cylindrical lens means one which refracts a pencil of parallel rays thus: (1) those which strike it parallel to the transverse diameter of the cylinder are focussed at six inches from the surface of the lens; (2) those which strike it parallel to the axis of the cylinder are not focussed at all by the lens, but pass through it refracted not more than they would have been by passing through a piece of plain glass."*

Hence may neutralize astigmatism.

To counteract, therefore, defective vision induced by astigmatism, in which the principal meridian is normal, the other being myopic or hypermetropic, a cylindrical lens is employed; the rays passing through its axis undergo no change, while those passing through a plane at right angles to this, should undergo the amount of refraction necessary to neutralize the abnormal condition of the corresponding meridian of the cornea; and the same principle applies to the other forms of astigmatism.†

Must be adapted to individual cases.

Having, therefore, in the first instance, discovered the exact nature of the changes that have occurred in the curvature of the cornea, cylindrical glasses must be adapted to counteract the abnormal refraction. A considerable amount of study and experience is required, to enable one to master difficult and complicated cases of this kind; but having once overcome them, one of the greatest triumphs in the practical application of ophthalmic science is achieved—namely, the adaptation of cylindrical glasses to correct the impairment of vision caused by astigmatism.

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* "Optical Defects of the Eye," by J. Z. Laurence, p. 65.

† *Vide* S. Wells' "Lectures," p. 192.

Illustrative case from Donders.

As an example I may give one of Donders' cases as illustrating the method by means of which we may select glasses for a patient suffering from astigmatism:

Mr. V., aged fifty-nine years. The *right* eye is nearly emmetropic: improvement of vision at a distance by convex $\frac{1}{60}$ is doubtful; concave $\frac{1}{60}$ acts injuriously.

From youth the patient has been unable to use his *left* eye; however, there exists neither obscurity nor organic change in the fundus oculi. Positive and negative spherical glasses produce no improvement. The reflected images of the cornea had suggested the idea of asymmetry. Examination with the ophthalmoscope afforded the proof of it: in the non-inverted image, I, as an emmetrope, saw, with some tension of my accommodation, vertical vessels of the retina perfectly acutely; horizontal vessels, on the contrary, appeared, on tension of accommodation, very faint, and on perfect relaxation were not well defined. I hence inferred the existence of myopia in the vertical, and of hypermetropia in the horizontal meridian. On examination with the point of light, the principal meridians seemed to deviate little from the vertical and horizontal planes; the most slender vertical line was seen with convex $\frac{1}{45}$, the most slender horizontal with concave $\frac{1}{30}$. The diagnosis was: mixed astigmatism $=\frac{1}{18}$ composed of

$$\text{Myopia } \frac{1}{30} + \text{Hypermetropia } \frac{1}{45}.$$

The cornea more than fully accounted for this: the radius of curvature in the visual line amounted, in the horizontal plane, to 8·29 mm, in the vertical=7·69,—indicating an astigmatism of 1 : 11·67. While (at least by the method with the point of light) only a mixed astigmatism $\frac{1}{18}$ was found, the crystalline lens appeared to compensate in part for the astigmatism of the cornea.

Quite in accordance with the ametropia in both principal meridians, the left eye sees at a distance vertical lines a little better than horizontal. With convex $\frac{1}{45}$ horizontal lines are still more indistinctly visible, while vertical lines are acutely seen. *Vice versâ*, with concave $\frac{1}{30}$ horizontal lines are very well seen, vertical lines, on the contrary, are only faintly perceptible. . . . . .

For distance, a flat glass was prescribed for the right eye; for the left a bi-cylindrical glass of $\frac{1}{48}\,c \ulcorner -\frac{1}{30}\,c$. For close work, I was anxious, the acuteness of vision not being perfect, to bring the far point to 12″. This was effected by means of a spherico-cylindrical glass of $\frac{1}{20}\,s \supset \frac{1}{18}\,c$: with $\frac{1}{20}$, in fact, the far point in the vertical meridian ($\frac{1}{30}+\frac{1}{20}=\frac{1}{12}$) becomes=12″, and with $\frac{1}{18}\,c$, the far point in the horizontal is made equal to the far point in the vertical. Hereby the right eye now acquired simply $\frac{1}{12}\,s$. The images were of nearly equal magnitude, and the vision was with both eyes at the same time very pleasant. Vision with the left eye was more acute than with the right.*

Artificial pupil.

Should the astigmatism have been induced by ulceration of the cornea, it will often be necessary to make an artificial pupil, and then, with the aid of cylindrical glasses, the patient's sight will probably be vastly improved.

ASTHENOPIA.

ASTHENOPIA.

Asthenopia, or feebleness of vision arising from defective or irregular muscular action, the internal rectus being at fault in motor asthenopia, and the ciliary muscle in the accommodatory form of the disease.

1. Motor variety.

1. *Motor Asthenopia.*—If a ruler, or any other object, be held at a distance of some twenty feet from a person's face, and he be directed to keep his eyes steadily fixed on it, as it is gradually brought nearer to him, we notice that his eyes converge upon it; and, when the object is brought within four inches of them, they will be inverted in a marked manner. This inward movement of the eyes is symmetrical in healthy vision, so that the rays of light proceeding from the object under observation, fall upon precisely corresponding spots on both retinæ (the maculæ luteæ). If, however, from any cause, the power of the internal rectus in one or both eyes becomes weakened, so that

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* Moore's Translation of Donders, p. 530.

Failure of internal rectus;

when the patient is engaged in looking at a near object, as for instance in reading, the muscle can no longer contract sufficiently to counteract its antagonistic muscle; under these circumstances, the eye, in place of being inverted, will be more or less everted by the external rectus, and the rays from the object under examination not falling upon exactly similar points of the retinæ in both eyes, diplopia results (Fig. 47). It is this condition which constitutes motor asthenopia.

from overstraining in near sight.

In the case of a person suffering from myopia, it is evident that, as he reads or writes with the book or paper close to his eyes, the internal recti must be kept constantly contracted; and from being thus overstrained, in course of time the muscle becomes exhausted, and the person being no longer able to maintain the effort necessary to invert the eyes, the external rectus asserts its superiority, and the globe is turned outwards. This is often increased by the peculiar conformation of the eyeball, which being elongated in the antero-posterior axis its centre of motion becomes altered, necessitating increased action of the internal rectus to converge the eye upon near objects; and thus the tendency to motor asthenopia, from overstraining of the internal rectus, is augmented.

Causes divergence.

Effect on vision. Words run together.

If a change of this kind in the direction of the eye takes place while the patient is reading, the words appear to run into one another, and become very indistinct, and he is obliged to rest his eyes for a time till the exhausted muscle can recover itself. Should the patient, however, in place of discontinuing his work, endeavour by an increased effort to go on with it, he may possibly be able to do so for a short time; but the eyes then begin to give him pain from congestion of the choroid, and headache supervenes, so that he is ultimately compelled to take rest.

Headache.

Common in myopia.

Motor asthenopia, therefore, is seldom met with, unless among myopes, or those engaged in work which necessitates their bringing the object upon which they may be employed very close to the eye; in either case the overstraining of the internal rectus is the origin of the disease.

The symptoms of this affection are those I have above described: the patient complains that, after writing or reading for a time, the words or letters appear to run into one another; and if he persists in using his eyes, he suffers from pain in them, extending to the eyebrow and side of the head. After resting for an hour or so, these symptoms disappear, and he can again continue his employment for a longer or shorter period.

Relieved by rest.

Diagnosis.

The simplest way of detecting the existence of this form of asthenopia, is to place a ruler or some such object in front of the patient, and direct him to look at it steadily while you slowly bring it nearer to within half a foot of his face. If motor asthenopia exist, we shall notice, in the course of a few minutes, that one of the patient's eyes will begin to quiver, and then gradually become everted, and he will at once tell you he can no longer see the object distinctly.

V. Graefe's prism test.

Von Graefe has devised a very simple means of detecting not only the existence but also the degree of motor asthenopia. A black spot, about the size of a split pea, is to be made on a sheet of white paper, and through this spot a perpendicular line must be drawn. The patient is then directed to look steadily at the figure, and a prismatic glass, with its base turned upwards, is to be placed before first one eye, and then the other. If he be emmetropic, the prism will simply cause two spots to appear on the paper, one above the other; but if asthenopia should exist in either eye, one of the spots will be seen in its real position, and the other above it, and to the right or left of the perpendicular line. Now, in order to discover the degree of diplopia, which is the cause of this deviation of the spot from the perpendicular line, all that is necessary is, to put a second prism, with its base outwards or inwards as the deviation of the spot may indicate, in front of the first one. The angle of the prism, required to restore the spot to its position on the perpendicular line, will indicate the amount of existing diplopia.

The degree of divergence ascertained.

Treatment.

The Treatment of motor asthenopia may either be palliative by means of glasses, or complete, by division of the muscle antagonistic to the weakened one.* If

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* Donders remarks that "Von Graefe has established the indications for tenotomy with great accuracy. The condition for the operation is this, that under the attempt at single vision, a sufficient divergence of visual lines should appear to be pos-

By concave lenses.

Prisms.

the former plan of treatment be adopted, the use of concave lenses, by preventing the necessity of the patient's bringing objects very close to his face, as in reading and writing, saves the constant strain which would otherwise be exerted on the internal rectus; and by husbanding the strength of this muscle, enables it to contract when called on to do so, and to converge the optic axes upon an object close before the eyes. Or we may, by the use of proper prisms, correct the diplopia by bending the rays of light upon the macula lutea of the everted eye, in this way reproducing binocular vision.

Division of external rectus.

In very slight cases these means may prove effectual; but in the majority of instances it will be necessary to do more than this, and to cut through the tendon of the external rectus. Great care, however, is necessary to divide only so much of the muscle as will prevent it from overcoming the contractile power of the internal rectus, otherwise we shall simply complicate matters by converting the external into an internal strabismus. If the operation be properly performed, and the muscle antagonistic to the overstrained one, whichever that may be, is carefully divided, motor asthenopia cannot, of course, exist (*vide* Chap. XIV.).

2. Accommodatory asthenopia.

No eversion.

Words run together.

2. *Accommodatory Asthenopia.*—The symptoms of this form of disease are very much akin to those described as characteristic of motor asthenopia, except that the patient's eye is not everted after being used for a time. Patients suffering from accommodatory asthenopia, have often very good long and short sight; they simply complain of the words or letters they may be reading appearing confused, and running into one another after a few hours' work. If,

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sible. This should be tried (after neutralization of the myopia by concave glasses placed at a proper distance from each other) with prismatic glasses; we should investigate with what prismatic glasses, held with the refracting angle outwards before the eyes, single distant vision is still attainable. The strongest glasses then which can still be overcome give the measure of the possible divergence. It is allowable now so to perform tenotomy that this possible divergence shall be completely removed. If the strabismus is evident without prisms, there can be no doubt of the propriety of dividing the internal rectus."—Moore's Translation of Donders, p. 428.

in spite of this, an effort is made to continue reading, the eyes become painful and weary, and it is then absolutely necessary to rest them for a time; but in ten minutes or a quarter of an hour the patient can resume his employment.

From fatigue of ciliary muscle.

These symptoms arise from inability on the part of the ciliary muscle to keep up the accommodative effort, which is necessary for bringing divergent rays to a focus on the retina. The muscle, from being overworked, or from general debility, soon becomes fatigued, and being no longer able to contract, it gives way: the anterior surface of the lens then recedes, so that parallel rays of light are alone correctly focussed on the bacillar layer. The patient can therefore see objects at a distance, although the words he may be reading or writing appear indistinct. A little rest speedily restores the power of the ciliary muscle, and he can again set to work for a time.

Ophthalmoscope in diagnosis.

The ophthalmoscope may be useful in these cases, to enable us to ascertain that no positive disease exists, either in the dioptric media or the fundus of the eye. Hyperæmia of the retina, it is true, will generally be detected; and, as I have before observed, this should never be regarded as a small matter, although in this instance it may not indicate any serious derangement of nutrition, being merely an effect of the prolonged strain to which the apparatus of the eye has been exposed in the effort to maintain the necessary accommodation.

Hypermetropia a cause.

The majority of cases of accommodatory asthenopia depend upon hypermetropia, and when this is corrected with proper convex glasses, the ciliary muscle, being no longer overstrained, will be able to maintain the necessary convexity of the lens to focus divergent rays, and the symptoms of asthenopia will disappear. But a long residence in the tropics, severe illness, and, in fact, any cause which impairs the tone of muscular fibres of the ciliary, together with that of the other muscles of the body, may produce accommodatory asthenopia. Under any circumstances, a pair of weak convex glasses, by increasing the refractive power of the eye, will obviate the necessity for any great alteration in the convexity of the lens for

Corrected by convex glasses.

Rest and tonics.

near objects, and thus relieve the ciliary muscle; but the patient should be enjoined to rest the eye as much as possible, and very often a tonic plan of treatment is called for. I have known several cases of this kind, in which the asthenopia had apparently been brought on by general derangement of the health, and a change to Europe entirely removed the troublesome symptoms from which the patients were suffering.

Should the asthenopia depend on H., we must discover the degree of defect which exists in the refractive power of the eye, and supply this deficiency by means of proper convex glasses.

CHAPTER XVI.

CONGENITAL MALFORMATIONS AND DISEASES OF THE EYE.

Congenital Affections. A FEW remarks on this subject may be useful, although, with one or two exceptions, these cases are similar to those already described in the foregoing pages. The fœtus is doubtless subject to diseases of the eye *in utero*, the results of which may be apparent at birth in the form of opacities of the cornea or synechia, especially if the parents have suffered from syphilis. The congenital malformations and diseases of the eye, however, may be briefly passed in review in the same order as that I have adopted throughout this work.

Epicanthus. *Malformations of the Eyelids and other Appendages.*— Epicanthus consists of a deep fold of skin along the side of the root of the nose, overlapping the inner angle of the eye and completely hiding the caruncle. A modification of this condition is common to all the Burmese and Chinese races: their flat nasal bones and the loose fold of skin covering the inner angle of the eye are peculiar to these people, and as they advance in life present the appearance of an epicanthus.

Ptosis. Ptosis is at times a congenital affection, and when occurring under these circumstances, usually depends upon a defect of the levator palpebræ muscle, and is, therefore, almost hopelessly irremediable.[1]

Malpositions of the lids. Ectropium, entropium, and trichiasis have been met with in the new-born infant, following, in all probability, inflammatory affections of the conjunctiva during the child's fœtal state.*

Union. Mr. Travers mentions an instance of a child having been born with the eyelids united (anchyloblepharon).

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[1] Mr. Wilde on "Malformations and Congenital Diseases of the Organs of Vision," p. 12.

Several cases have been recorded in which the palpebral apertures were so much constricted, that it was impossible for the patient to do more than just separate the eyelids; in other cases the same result has been observed as a consequence of a shortening of the upper eyelids.

Nævi.

Nævi of the lids, as already mentioned, are generally congenital affections; I have before described their nature and treatment, and will not, therefore, enter further on the subject in this place.

Muscular malformations.

Congenital malformations of the muscles of the eye are by no means of common occurrence. Doubtless abnormalities in the development of one or more of the muscles frequently take place during the period of infant life, but, according to Mr. Wilde, these changes as a general rule, arise subsequently to the child's birth. The influence which a faulty insertion of the superior oblique may have upon the eye, has been already discussed (in the section on posterior staphyloma), being equivalent to deficiency of the internal rectus.

Oscillation of eyes in those born blind.

Alteration in the contractile power of the muscles of the eye, if it exists, can hardly be recognised as a congenital malformation. Nystagmus or an oscillatory motion of the eyes is generally present among those who are born blind, though it by no means always indicates that the little patient is absolutely blind; for I have operated on cases of congenital cataract in which this oscillating motion of the eyes was well marked, and after removing the lens the patient has gained useful vision.

Rudimentary eyes.

Malformations of the Globe.—The eyeball may never have been formed, or only partially developed, the orbit being more or less filled with loose connective tissue at the time of birth. In instances of this kind the eyelids sink in from want of their natural support, but on being drawn open the rudimentary eye may generally be seen as a small button-like process at the bottom of the orbit. The converse of this condition has been described under a very formidable name (hydromegalophthalmus), the eyeball being congenitally formed of a larger size than natural; and in some cases a communication has been said to exist between the ventricles of the brain and the interior of the eyeball.

Monstrous ones.

I am unable to state if the flattening of the globe of the eye from before backwards, which is the cause of hypermetropia, is usually a congenital affection or not. The impairment of sight thus engendered is hardly apparent until the child is three or four years of age, and it would be difficult to determine, therefore, if the misshapen eyeball were due to congenital defects or to subsequent imperfect growth.

Hypermetropia.

Congenital Affections of the Conjunctiva and Cornea.—Nævi of the conjunctiva have in some few cases been noticed at the time of a child's birth. Various forms of tumours have also been observed. Xeroma of the conjunctiva, arising in all probability from inflammation and obstruction of the conjunctival glands prior to birth, has been described by several authors.

Tumours.

Xeroma.

Opacities of the cornea are not uncommon, depending on disease of that structure having taken place *in utero.* In other cases, an arrest of development taking place in the cornea, about the third or fourth month of fœtal life, it retains the opaque appearance natural to it at that period; in these cases the cornea is not only opaque, but also of smaller size than in the healthy fœtus.

Corneal opacities.

Vesicular keratitis has been observed at birth; the cornea, becoming attenuated, yields to the intra-ocular pressure, and a prominent and hazy condition of this important structure is the result.

Keratitis.

Malformations of the Iris and Choroid.—Cases in which there is an entire absence of pigment in the cells of the iris and choroid, and it may be of the entire body (Albinos), are met with from time to time. This condition is congenital and hereditary. Among the natives of India the Albino is looked upon as a leper, and consequently an outcast from society; marriage is forbidden him, and thus the propagation of the disease is usually checked.

Absence of pigment.

Albinos.

The irides may vary in colour: this is usually a congenital malformation; but among patients affected with leprosy, an alteration in the pigmentation of the irides may be seen to occur in after-life.

Synechia, the result of vesicular keratitis, or of iritis taking place *in utero*, is a congenital affection, which has often been described. A deficiency of a portion of the iris, or coloboma iridis, like hare-lip, is now and then seen in the newly-born infant.* The cleft in the iris usually extends outwards from the pupil, and is generally present in both eyes. The most common form

Synechia.

Coloboma, or cleft iris.

Extends to choroid.

of coloboma is a prolongation of the pupil downwards, the edges of the pupil dilating and contracting to a greater or less extent on the stimulus of light. This malformation of the iris is generally accompanied by a deficiency in the corresponding portion of the choroid, so that on looking through the cleft iris with the ophthalmoscope, the white and glistening sclerotic may be seen at the back of the eye to an extent equal to that of the defect in the iris.

Absence of iris.

An entire absence of the iris, occurring as a congenital defect, has been met with; but in the few recorded cases the patient's sight was so defective, when not altogether wanting, that we have reason to believe the eye must have been very imperfectly developed in other respects besides that of the deficient iris. It will be remembered, in Professor Von Graefe's case of removal of the iris, that the patient's sight remained remarkably good; so that a loss of the iris alone does not induce blindness.

Partial deficiency of choroid.

Independently of coloboma of the iris, instances of a partial deficiency of the choroid are met with from time to time. On examining the eye with the ophthalmoscope, a white patch of varying size is noticed, occasioned by an absence of the choroid, and the reflection from the glistening sclerotic of the light thrown into the eye by the ophthalmoscope. In cases of this description, the vessels of the retina are healthy, and may be seen coursing over the sclerotic; in fact, the remainder of the fundus of the eye is normal, and in this way we at once distinguish a case of congenital absence of a part of the choroid, from neoplastic formations, or other changes in the part, the result of disease.

Retinal opacity.

Retina and Optic Nerve.—Liebreich has described various forms of opacity of the retina, arising from a prolongation over it of a portion of the opaque nerve-fibres of the optic nerve. In the normal state, the axis-cylinder only of the nerve is prolonged beyond the lamina cribrosa. The reflection from the opaque nervous substance is by no means always confined to the neighbourhood of the papilla, for Liebreich states that he has noticed spots of opacity of this kind toward the periphery of the retina, the nervous structure between the opaque spot and the papilla being perfectly healthy (Fig. 2, Plate XII., of Liebreich's "Atlas"). With the exception of these congenital anomalies in the retina, the fundus of the eye may be healthy, and the patient's sight is unaffected.

Liebreich also mentions a remarkable case of congenital pigmentation of the papilla.

Excavation of optic disc.

I have before remarked, that in some few cases a congenital malformation of the lamina cribrosa has been noticed, the disc projecting backwards, and being in fact cupped. It is seldom that more than a part of the disc is thus affected, and the patient's sight may be perfect, the fundus of the eye, with the exception of the papilla, being normal in every respect.

Soft and zonular cataracts.

Congenital Cataracts.—Soft cataracts are by no means unfrequently met with, having evidently existed at the time of the infant's birth.

The zonular form of cataract is also for the most part a congenital affection; but as I have fully described its characteristic features and treatment in a former section, I need not return to the subject here, but refer the reader to Chapter XIII. of this volume for further information upon this important congenital affection of the lens.

SNELLEN'S TEST TYPES.

1½.

We all know that light comes from the sun. But what is light? It used to be thought that the rays of light were things too small to see, which came out from the sun and darted down to the earth, and that there were such a number of them, and they came so fast, as to look like one sheet of light. But it has been found that this cannot be the case. For one thing, even though the rays were more fine than air, and far too small to be seen, yet coming so far and so fast they would have force enough to hurt our eye when they got into it. But then what is light? It seems to dart down

2.

Rhine the progress of defection and the decay of national enthusiasm, he determined to be beforehand with those who were now his enemies. He accepted the offer of negotiation from Cerialis. The Roman general was eager to grant a full pardon, and to re-enlist so brave a soldier in the service of the empire. A colloquy was agreed upon. The bridge across the Nabalia was broken asunder in the middle, and Cerialis and Civilis met upon the severed sides. The placid stream by which Roman enterprise had connected

3.

remarkable foreshadowing of the future conflict with Spain, through which the Batavian republic, fifteen centuries later, was to be founded. The characters, the events, the amphibious battles, desperate sieges, slippery alliances, the traits of generosity, audacity, and cruelty, the generous confidence, the broken faith seem so closely to repeat themselves, that History appears to present the self-same drama played on

3½.

selfsame drama played over and over again, with but a change of actors and of costume. There is more than a fanciful resemblance between Civilis and William the Silent, two heroes of ancient German Stock, who had learned the arts of war and peace in the service of a foreign and haughty world-empire. Determination, 4½.

concentration of purpose, constancy in calamity, elasticity almost preternatural, self-denial, consummate craft in political combinations, personal fortitude, and passionate patriotism, were the heroic elements in both. The ambition of each was subordinate to the

6½.

from the sun; how does it come? Many thought that the whole space around the earth, and things upon the earth into which light can get, are full of something

12.

more fine than air, and called ether. The sun is full of ether also. Now the sun is a world